JPRS-UMS-87-006
6 JULY 1987

FOREIGN BROADCAST INFORMATION SERVICE

JPRS Report

Science & Technology

USSR: Materials Science

JPRS-UMS-87-006
6 JULY 1987

SCIENCE & TECHNOLOGY

USSR: MATERIALS SCIENCE

CONTENTS

/9835

RESTORATION OF METAL-STRENGTH LABORATORY URGED

Moscow IZVESTIYA in Russian 11 Oct 86 p 2

[Article by N. Prokhorov, doctor of technical sciences, professor, Moscow Higher Technical School imeni N. E. Bauman, under the "Fact of the Matter" rubric: "How Strong is Strength Science?"]

[Text] The quality of materials and the quality of their processing determine to a great degree the level of scientific-technical progress. It's no accident that the stages of human development are divided into ages: stone, bronze and iron. How about the present age, and especially the coming age? They, undoubtedly, will go down in history as the age of intensive utilization of all the chemical elements on our planet.

But there is a contradiction here. It turns out that increasing the productivity of processing very-high-strength materials often leads to reduced article reliability. For example, with an increase in the initial strength of welded alloys, all other conditions being equal, the probability of crack formation increases, rather than decreases. This is delaying the start of production of high-strength alloys and, as a result, is leading to higher metal content in articles.

Moreover, there are some types of articles where metal conservation is not as important as high reliability. For instance, it is vitally important that aircraft have two properties simultaneously: reliability and lightness. In the history of world scientific-technical progress, there are many cases where the use of high-strength alloys without sufficient knowledge of the processes occurring within them during welding has led to massive cracking. In these cases (involving the use of high-strength steels, titanium and aluminum alloys, heat-resistant alloys etc.), designers were forced to switch to weaker materials, thus increasing the metal content in the designs.

A fundamental problem of modern technology is to overcome the contradiction between the desire to use materials with high initial strength, the necessity of using concentrated energy sources to process these materials and the resulting reduction in article reliability. The solution of this problem led to the creation of a new branch of science, which I call the technological strength of metals.

Our country has tens of thousands of laboratories and hundreds of thousands of machines and instruments for evaluating the operating properties of alloys, but there was not a single specialized subdivision which was fully dedicated to the analysis of the technological strength of alloys. Thirty years ago, with the support of two leading welding scientists, academician N. Rykalin and academician B. Paton, chairman of the Coordinating Council on Welding of the USSR Academy of Sciences, a laborabory specializing in the study of material behavior during welding was established at the Moscow Higher Technical School imeni N. E. Bauman [MVTU]. This was an important step, which gave us the promise of a leading position in world science in this direction.

Much has been done since then. The methods developed by our laboratory of evaluating the technological strength of metals during welding have become recognized and used in many countries; our testing machines are being installed in this country and also exported.

It is no accident that the laboratory was established at an educational institute. Rather than just becoming acquainted with an assortment of facts, as was the case previously, future engineers could be taught the fundamentals of new science, using the achievements of metal physics and thermodynamics. Academician B. Paton invited me to write a monograph-textbook "Physical Processes in Metals During Welding" (two volumes have already been published) and to prepare a course of lectures and teaching aids for a program approved by the USSR Ministry of Higher and Secondary Specialized Education.

But I'm not writing this to "report on past work." It is with bitterness that I must say that the laboratory of technological strength (the only one in the country) at the Bauman School no longer exists. In 1982, it was eliminated as an independent unit and separated into a number of subgroups working without creative cooperation or unified leadership. The pace of scientific development has dropped sharply.

In short, what has happened, unfortunately, is not such a rare occurrence in institutions of higher education and scientific establishments: the requirements of the economy and the general state requirements do not "fit" with "their" plans and interests.

Recently, we have sharply and openly talked about the poor quality of articles and metal structures, but we habitually explain it away by the poor quality of technological discipline at an enterprise or by the low technical level of production; this is the easiest way out. However, no less responsible for quality and reliability is fundamental science, which must learn to predict and predetermine the strength margin and prevent premature failure.

It seems that many people understand this. At one time, the MVTU rectorate and the publisher producing our textbooks sent a questionnaire to 10 leading welding organizations. The questionnaire asked for opinions on the importance of the problem of the technological strength of metals and on the quality of our developments. The answers were largely the same: this is important, fruitful and vital. And at the same time, I must report with

dismay that during this time, we have lost one of the leading positions in world science on the technological strength of metals. By unjustifiably cutting back the research in this field and reducing the level of student preparation, we are programming a future lag in solving a cardinal problem of the strength of welded structures. Before sending this letter, I asked for the opinion of academician B. Ye. Paton on the importance of this problem and received the following answer: "I completely agree and support your point of view on the fact that without scientific knowledge on the technological strength of metals, in particular during welding, scientific-technical progress in machine building and construction is impossible."

What I am talking about probably is beyond the scope of tasks for a single higher-education institution or a single scientific establishment. I submit that ensuring the reliability of welded structures made of high-strength materials is a task of state importance.

But reliability science itself needs reliable guarantees for the future. These guarantees can be provided only on the basis of a qualitative restructuring of the management of scientific-technical progress.

12595
CSO: 1842/2

UDC 621.039.531

SUPERCONDUCTIVITY OF PSEUDOBINARY COMPOUNDS A15 $(V-Cr)_3Si$, $(V-Mo)_3Si$, $Mo_3(Si-Re)$, BOMBARDED WITH FAST NEUTRONS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 62, Issue 2, Aug 86 (manuscript received 21 Jun 85; in final form 10 Oct 85) pp 291-297

[Article by A.Ye. Karkin, V.Ye. Arkhipov, A.V. Mirmelshteyn, V.I. Voronin, A.K. Shtolts and B.N. Goshchitskiy, Metal Physics Institute, Ural Science Center, USSR Academy of Sciences]

[Abstract] A study is made of the influence of neutron bombardment on the behavior of T_c (superconducting state transition temperature), second critical field H_{c2} and electric resistance ρ (T) of the compounds mentioned in the title. When quasibinary compounds A15 are bombarded with fast neutrons, T_c decreases where z (average number of electron per atom) = 4.5-5.0, increasing where z = 5.0-6.0 and decreasing slightly where z = 6.25-6.5. The variation of T_c as a function of z for compounds based on V, Cr, Nb and Mo is transformed from a 2-peak curve to a monotonically increasing curve similar to T_c (z) observed for amorphous metals, disordered compounds and alloys with different crystalline structures. The A15 compounds lose their individuality upon disordering or amorphization. The density of electron states at the Fermi level $N(E_F)$ is not simply related with the behavior of T_c. Correlation of T_c and $N(E_F)$ is weak or nonexistent. References 17: 5 Russian, 12 Western.

6508/9835
CSO: 1842/12

UDC 539.216.2:537.311.31

INFLUENCE OF LOW CONCENTRATIONS OF SILVER AND GOLD IN INTERGRAIN BOUNDARIES OF GOLD AND SILVER FILMS ON GRAIN BOUNDARY SCATTERING OF ELECTRONS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 62, Issue 2, Aug 86 (manuscript received 13 May 85; in final form 18 Oct 85) pp 298-302

[Article by Yu.A. Volkov, R.P. Volkova and A.T. Pugachev, Kharkov Polytechnical Institute imeni V.I. Lenin]

[Abstract] A study is made of the influence of small concentrations of gold and silver in the intergrain boundaries of silver and gold films on the grain boundary scattering of electrons. Initial base films of Au and Ag were prepared in a vacuum on mica and cover glass specimens at 350-600 K. The films were annealed at the same temperature to stabilize the defect structure and resistivity. The thickness of the diffusant film was not over 10% of the thickness of the initial base film. Immediately after condensation of the diffusing component, in situ potentiometric measurements of R by a 4-probe method were performed. The substrate temperature was stabilized with an accuracy of 0.1 K during diffusion annealing, allowing accurate measurement of resistivity. Diffusion penetration of impurity atoms into the intergrain boundaries of the base films was found to decrease resistivity. The decrease in electron scattering coefficient of the grain boundaries was found to be proportional to the concentration of the diffusing impurity. The boundary resistance was 10-50% of the total resistance of the films, the variation in resistance 1-5%. References 11: 6 Russian, 5 Western.

6508/9835
CSO: 1842/12

UDC 621.762

HYDRAULIC CHARACTERISTICS OF TITANIUM-BASED POROUS POWDER MATERIALS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 86 (manuscript received 10 Oct 85) pp 53-56

[Article by A.G. Kostornov, N.V. Manukyan, L.G. Galstyan and S.M. Agayan, Institute of Materials Science Problems, Ukrainian Academy of Sciences; Yerevan Polytechnical Institute]

[Abstract] The purpose of this study was to determine the basic structural-hydraulic properties of porous titanium-based powder materials alloyed with 7% copper. Specimens 50 mm in diameter and 2 mm high with a porosity of 25 to 70% were manufactured. To obtain quantitative characteristics of the structure of the porous materials, their gas permeability, maximum and mean

pore size and pore channel convolution factor were determined. The gas used to study the permeability was compressed air. Analysis showed that the pore diameter depends both on porosity and on initial powder particle size. Increasing porosity from 25 to 45% increases maximum pore diameter. As porosity increases, the pore convolution factor also increases. References 6: all Russian.

6508/9835
CSO: 1842/15

UDC 621.762.4.043:620.186.5

TEXTURE OF HOT PRESSED VANADIUM CARBIDE-CARBON MATERIALS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 86
(manuscript received 25 Jun 85) pp 60-63

[Article by V.V. Pakholkov, S.G. Gorinskiy, A.R. Beketov, I.L. Shabalin and S.V. Rogozin, Urals Polytechnical Institute; Sverdlovsk Engineering-Pedagogical Institute]

[Abstract] The methods of metallographic analysis and measurement of resistivity through the volume of pressings are used to study the texture of graphite inclusions in a pressing of a vanadium carbide-carbon material with a volumetric graphite content of 10%. A cylindrical specimen, relative density 99.7%, was obtained by uniaxial hot pressing of vanadium carbide plus graphite powders at 2600 K and 8.0 MPa. Plates were cut across an axial cross section, then ground with corundum disks and studied on a metallographic microscope. A change was observed through the volume of the specimen in primary orientation of inclusions and in degree of orderliness of distribution. The entire volume of the cylindrical specimen can be divided into two major zones: the central zone, a cylinder with half the diameter of the specimen, and a wall zone. In the central zone the graphite flake inclusions are primarily perpendicular to the hot pressing axis. In the wall zone, the texture is less determined by distance from the base than in the center zone. The planes of the graphite flake inclusions tend to rotate parallel to the walls. The influence of friction of the powder with the side surface of the press mold thus alters the structure of the wall zone of the pressing. References 5: all Russian.

6508/9835
CSO: 1842/15

UDC 621.793.14.74

CONDITIONS OF INTERACTION OF MATERIALS UPON GAS-THERMAL SPRAYING OF METALLIZED OXIDE POWDERS ONTO AK-4 ALLOY

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 86
(manuscript received 6 Nov 85) pp 48-52

[Article by N.N. Novikov, S.R. Pustotina and V.A. Verkhovodov, Odessa Food Industry Technological Institute]

[Abstract] An analysis is presented of the conditions of the physical and chemical interaction of protective layers and the base of aluminum alloy AK-4 during creation of heat-protective coatings of composite Al_2O_3+Al, Al_2O_3 + Al + Ni and ZrO_2 + Al + Ni powders. The contact interaction of the materials was studied with application of coatings directly to the AK-4, to sublayers of chemically precipitated nickel and its aluminide, and also with application of pure oxide coatings of Al_2O_3 and ZrO_2 onto aluminum oxide layers. The analysis is based on thermodynamics and the quasi-chemical theory of bond formation during gas-thermal spraying. This analysis indicates that aluminum oxide composites have a definite advantage and that surface oxide films are important in the creation of reliable heat protective coatings. Cotaings based on ZrO_2 are most desirable, with a change in the nature of the oxide film on the surface of the AK-4 alloy by preliminary formation of an NiO sublayer. Use of metallized oxide powders significantly increases the energy of the contact interaction of the material on the substrate. The components of the metallized powders interact to form Zr-Al and Zr-Al-Ni oxidized phases. The depth of mutual diffusion of coating and base elements is 0.5-3 μm. Bond strength of the heat protective coating with the alloy surface may reach 20-25 MPa. References 4: all Russian.

6508/9835
CSO: 1842/15

UDC 621.762:669.245

ELECTROLYTIC CLADDING OF IRON POWDER WITH COBALT AND COBALT-NICKEL ALLOY

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 25 Mar 86) pp 1-4

[Article by L.M. Kurvyakova, L.I. Korneyev and V.I. Yurov, Novomoskovosk Branch, Moscow Chemical Technology Institute; Tulachermet Scientific-Production Association]

[Abstract] A study is made of the conditions of electrolytic precipitation of cobalt and its alloy with nickel onto particles of iron powder. The influence of electrolyte composition, current density and temperature on current efficiency and alloy composition is studied. The current efficiency of the alloy dropped sharply with decreasing concentration of cobalt ions in the solution. The yield of cobalt, nickel and the alloy passed through a maximum with increasing current density. Current density also influenced the composition of the alloy: with increasing current density, the cobalt content of the precipitate decreased and nickel content increased. A hgih relative cobalt content can be achieved by the use of electrolytes with high cobalt concentration at low current densities and at room temperaure. References 4: all Russian.

6508/9835
CSO: 1842/16

UDC 621.762:8:621.793.7

GAS-THERMIC COATINGS ON POWDER MATERIALS. II. FUSED POWDER COATINGS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 12 May 85) pp 60-64

[Article by P.A. Kulu and Ya.A. Khalling, Tallin Polytechnical Institute]

[Abstract] Microscopic x-ray spectral analysis was used to study the structure and composition of the transition zone of coatings obtained by gas flame atomization and subsequent melting. When coatings of powders of self-fluxing type PG-SR alloys were applied, the fluxing which occurs protects the surface of the base even if its porosity is high. Iron actively diffuses into the coating. The structure of the transition zone is influenced by the method of application of the coatings. Gas flame atomization produces coatings 1.5-1.7 times harder than furnace melting. Gas-thermic coatings can reduce the requirements for base material properties, allowing the use of inexpensive iron-based materials. A powder base creates a more active and rougher surface than a compact base, increasing the bond strength between the gas-thermic coatings and the substrate. References 3: all Russian.

6508/9835
CSO: 1842/16

UDC 621.793.3

INCLUSION OF RHENIUM IN CHEMICALLY PRECIPITATED NICKEL-PHOSPHORUS COATINGS

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 5, Sep-Oct 86
(manuscript received 13 Jun 85; after revision 20 Jan 86) pp 748-753

[Article by I.K. Gyanutene, A.M. Lunyatskas and Yu.I. Lyankaytene, Chemistry and Chemical Technology Institute, Lithuanian Academy of Sciences]

[Abstract] A study was performed of the process of precipitation of Ni-P-Re coatings in a glycine-containing nickelizing solution. The solutions were precipitated on $PdCl_2$-activated copper plates or rough glass, the precipitation rate of the coatings being determined by a gravimetric method. The plasticity of the coatings was determined by bending the specimens around rods of various diameters. The magnetic properties were measured by a ferrometer which yielded values of induction and magnetic field intensity from hysteresis loop oscillograms. The optimal conditions of precipitation of the coatings were found to be 10-15 g/l $H_2PO_2^-$, 4-6 gL $KReO_4$, pH 7-9. The inclusion of rhenium decreases the content of phosphorus in the coatings, preventing reduction of phosphorus with nickel. The rhenium included in the nickel-phosphorus coatings is not always completely reduced to the metal. Increasing utilization of hypophosphate during precipitation of coatings under certain conditions apparently results from the possibility of utilizing atomic hydrogen for reduction of the perrhenate. The nickel-phosphorus-rhenium coatings produced are plastic and nonmagnetic. References 12: 11 Russian, 1 Western.

6508/9835
CSO: 1842/14

UDC 621.762

CORROSION RESISTANCE OF SILVER-PLATED CARBON-ALUMINUM COMPOSITE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 86
(manuscript received 27 Nov 84) pp 45-47

[Article by E.Z. Napukh, I.M. Zhitkikh, A.I. Stepanov, A.T. Manuylov, M.I. Morozova, S.I. Vorobeva, B.F. Trefilov and N.P. Ignatova, Moscow]

[Abstract] The purpose of this work was to study the corrosion resistance of silver-plated carbon-aluminum composite with matrices of aluminum alloys in the Al-Si(1), Al-Zn-Mg(2) and Al-Mg-Si(3) systems. Silver plating was performed in a cyanide-thiocyanate electrolyte over a sublayer of nickel and copper precipitated from an ethylene diamine electrolyte. Study of microsections showed that delamination of the matrix, pitting at points where carbon fibers protrude, occurs during its preparation and nickeliding, resulting in precipitation of chemical nickel, copper and silver at such defects, with porosity greater than that of the same coatings on uniform surfaces. It is concluded that good quality coatings on carbon-aluminum composites, providing good corrosion resistance and functional properties, can be obtained only if the thickness of the surface layer of aluminum containing no carbon fibers is at least as great as the thickness removed upon preparation for nickeliding, i.e., at least 30-40 μm. References 9: all Russian.

6508/9835
CSO: 1842/15

UDC 621.762.8:621.793.7

GAS-THERMAL COATINGS ON POWDER MATERIALS. I. SPRAYED POWDER COATINGS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 86
(manuscript received 12 May 85) pp 75-80

[Article by P.A. Kulu and Ya.A. Khalling, Tallin Polytechnical Institut3]

[Abstract] A detailed study is presented of the influence of properties of the base, sprayed material and method of its application on the bond strength, hardness and wear resistance of coatings. Specifics of application of coatings onto powdered steel are studied and recommendations are given for their selection under specific operating conditions. The base studied was type 45p steel made from iron powder containing about 0.45% carbon after sintering, plus cast type 45 steel for comparison. The gas plasma coating material was thermoreactive powder produced by one Soviet and one Swiss plant. Nickel-aluminum and aluminum and titanium oxide powders were used for plasma spraying. Alloyed steel, carbide and mixed powders were used for detonation coating. The properties of the coatings and the transition zone were found to depend significantly on methods of gas thermal spraying, composition and properties of the powder, the properties of the base, and its preparation. The distribution of microhardness through the transition zone of sprayed coatings on 45p steel by depth was uniform, with slight, sudden variations indicating that the indenter had penetrated pores. Only very rapid (such as detonation) application using powders of optimal hardness and ductility achieved coatings with wear resistance as much as 3 to 4 times greater than that of type 45 steel. References 4: all Russian.

6508/9835
CSO: 1842/15

UDC 620.196

ATMOSPHERIC CORROSION OF NONALLOYED STEEL, ZINC, COPPER, ALUMINUM AND ITS RELATIONSHIP TO CERTAIN CHARACTERISTICS OF THE AIR ENVIRONMENT. ANALYSIS OF RESULTS OF 10-YEAR TESTS PERFORMED IN THE EUROPEAN CEMA MEMBER NATIONS

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 5, Sep-Oct 86
(manuscript received 6 Dec 85) pp 675-683

[Article by P. Goller, D. Knotkova, M. Cherny, P. Strekalov, Z. Yegutidze, V. Kozhukharov and M. Zaydel, State Scientific Research Institute for the Protection of Materials imeni G.V. Akimov, Prague, CSSR; Physical Chemistry Institute, USSR Academy of Sciences; Institute for the Protection of Metals from Corrosion, Sofia, Bulgaria; Center for Corrosion Protection, Dresden, GDR]

[Abstract] The results of 10-year studies on open-air corrosion of metals conducted in the European CEMA member nations are outlined. Corrosion stations

in Czechoslovakia, the USSR, Hungary and Bulgaria exposed standard specimens of unalloyed carbon steel, zinc, copper and aluminum to the open air and under cover for periods of 90 days to 10 years. The results of corrosion testing were correlated with data on weather and atmospheric pollution. Quantitative estimates of certain characteristics important for corrosion at the test stations were thus obtained, allowing determination of stochastic relationships among the environment, time and corrosion. The network of stations used reflects the conditions in the temperature zone well in terms of relative humidity, air temperature, precipitation frequency and quantity. Figures 5; references 11: 8 Russian, 1 East European, 2 Western.

6508/9835
CSO: 1842/14

UDC 620.194

CORROSION-ELECTROCHEMICAL AND MECHANICAL PROPERTIES OF COMPOSITE GRAPHITE-CARBIDE METAL MATERIALS BASED ON TITANIUM AND ITS ALLOYS

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 5, Sep-Oct 86
(manuscript received 9 Apr 85; after revision 3 Dec 85) pp 684-691

[Article by N.D. Tomashov, T.V. Chukalovskaya, I.K. Krylov, V.S. Nabokov, V.S. Mikheyev, B.A. Goncharenko and N.I. Iudina, Physical Chemistry Institute, USSR Academy of Sciences]

[Abstract] A study is made of the corrosion-electrochemical and mechanical properties of composite carbide-graphite metal materials obtained by volumetric saturation of type EG-0 graphite with 20-25% porosity with titanium and alloys Ti-8Si and KRST-1, a corrosion-resistant titanium-based alloy containing molybdenum, niobium and zirconium, and also by precipitation of titanium from the gas phase onto a graphite matrix. The specimens produced were used to determine the mechanical characteristics, density, and phase composition of the outer surface layer and volume of the specimens. The materials obtained were found to have significantly greater strength than graphite and good surface layer hardness, while being significantly superior to titanium and KRST-1 alloy in terms of corrosion resistance in nonoxidative corrosive media at 100°C. The electrochemical behavior of the EG-0-Ti material showed that the anodic and cathodic properties of the material in H_2SO_4 at 50°C are determined basically by the titanium carbide. The hydrogen overvoltage of the material is some 300 mV lower than that of graphite and titanium. At cathode polarization, the hydrogen is absorbed in the carbide layer, so that the hydrogen overvoltage is reduced and the electrode acts like a reverse hydrogen electrode. The composition materials can be suggested as structural materials for parts and units operating without dynamic loading in nonoxidizing acids at temperatures up to 100°C. References 8: all Russian.

6508/9835
CSO: 1842/14

UDC 541.138.2:620.193.013

KINETICS OF ANODIC DISSOLUTION OF ALLOYS IN THE SYSTEM Ag, Au

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 5, Sep-Oct 86
(manuscript received 20 Nov 85) pp 705-709

[Article by I.V. Anokhina, A.V. Vvedenskiy, Yu.A. Stekolnikov and I.K. Marshakov, Voronezh State University]

[Abstract] The purpose of this work was to establish the nature of the kinetic limitations of selective dissolution of Ag, Au alloys in the area of supercritical potentials by anodic chronoamperometry. Rotating disk electrodes of the alloys were used in deaerated KNO_3 solutions at 25±0.5°C. Surface development of the alloys was found to begin when the critical potential was achieved and to be manifested as a sharp increase in anodic current. The rate of dissolution remains constant with respect to the true surface. The critical potential is determined by alloy composition and hydrodynamic conditions, plus the presence and concentration of complex-forming anions and surfactants in the corrosion medium. The kinetics of selective dissolution of the alloys at potentials over the critical potential is determined by nonsteady volumetric diffusion of silver in the alloy. References 18: 8 Russian, 10 Western (1 in Russian translation).

6508/9835
CSO: 1842/14

UDC 620.193.26:620.199

PREDICTING LOCAL CORROSION DAMAGE OF COPPER ALLOYS IN ELECTRIC POWER PLANT RECIRCULATING COOLING SYSTEMS

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 5, Sep-Oct 86
(manuscript received 9 Aug 85; after revision 6 Jan 86) pp 787-790

[Article by A.K. Khachaturov, A.V. Vvedenskiy, I.K. Marshakov, I.A. Malakhov and O.F. Stolnikov, Azerbaijan Petroleum and Chemistry Institute; Voronezh State University]

[Abstract] A study is presented of the application of electrochemical methods for determination of the tendency of copper alloys toward local corrosion damage in treated city waste water. Studies were performed on L63, L070-1, LOMsh70-1-0.05 brass specimens plus copper-nickel alloy MNZh-5-1 in the recycled water of a physical model of a power plant cooling system. Imitation waste waters were also used to determine the influence of individual components on the formation and development of corrosion. It was found that measurement of corrosion potential of alloys in several of the most characteristic zones of heat exchangers with subsequent comparison of these values with the pitting-formation potential determined by preliminary electrochemical studies can be used as a continuous and

nondestructive method of monitoring local corrosion of copper alloys in cooling systems. The alloys L070-1, LOMsh70-1-0.05 and MIZh-5-1 were found to be suitable for such use, provided monitoring is performed. References 10: 7 Russian, 3 Western.

6508/9835
CSO: 1842/14

UDC 620.197:621.793.14(047)

EFFECT OF MICROSCOPIC FUNGI ON VACUUM METAL CONDENSATES

Moscow ZASHCHITA METALLOV in Russian Vol 22, No 5, Sep-Oct 86 (manuscript received 22 Aug 85; after revision 20 Oct 85) pp 792-794

[Article by L.P. Bugayenko, E.Z. Koval, S.I. Sidorenko, I.Ye. Kotenko, L.P. Germash, M.A. Kuznetsov and O.V. Nikitina, Kiev Polytechnical Institute; Microbiology and Virology Institute imeni D.K. Zabolotnyy, Ukrainian Academy of Sciences]

[Abstract] A comparison of the fungus resistance of various vacuum condensates is presented and factors facilitating an increase in this resistance are investigated. Condensates of aluminum, vanadium, niobium, molybdenum, nickel, iron, tungsten, chromium and copper and its alloys with manganese, nickel, chromium, aluminum, cerium, zirconium, boron and others, more than 40 materials in all, were applied by thermal and thermoionic evaporation onto plates of ST-50-1 sitall with very smooth surfaces. The specimens were tested by applying 16 species of fungus and were observed each day for 30 days while being held at 28-29°C and 99% humidity. Layers produced by the thermoionic method were found to have higher fungus resistance than those produced by thermal evaporation. References 5: all Russian.

6508/9835
CSO: 1842/14

PROMISING DIRECT IRON-REDUCTION PROCESS DEVELOPED

Moscow SOTSIALISTICH[illegible]YA INDUSTRIYA in Russian 28 Sep 86 p 1

[Article by T. Meyrzhanova under the "Speed. Quality. Thrift" rubric: "Proposed by Scientists"]

[Text] Karaganda--This piece of metal is special. It was obtained not from a blast furnace or an open hearth, but from a brittle laboratory test tube, without the use of fire. It was produced by a new technology developed by scientists at the Chemical-Metallurgical Institute of the KaSSR Academy of Sciences.

It has long been a dream of scientists to develop fireless metallurgy and to eliminate the enormous expenditures of energy and coke. Today, this dream is becoming reality. The new technology is already "in operation" at the Oskol Electrometallurgical Combine, where a powerful stream of hot reducing gas processes pellets and sinter. Karaganda scientists have perfected this method. The installation, developed under the direction of professor B. Fialkov and candidate of technical sciences Ye. Maksimov, directly metallizes the iron-ore concentrates. This increases the active area of interaction between the material and gas, thus increasing the chemical reaction rate.

The "heart" of the installation is a patented metering device. Young graduate student A. Talzhanov proposed that the device be used to produce metallized concentrates. The iron is also reduced in the metering device. The end products are pure metal and ordinary steam. The capacity of the existing model is small, but the prospects are very promising.

"The advantage of our technology," says A. Talzhanov, "is the simplicity of achieving low-tonnage production, which can produce super-pure steel with specified technological properties. Probably, our technology will not be widely used in large-scale metallurgy, since it is designed for high-quality ores. However, it has great prospects for machine building, instrument building and the aviation industry.

12595
CSO: 1842/2

NOVOLIPETSK DYNAMO-STEEL SHOP PUT IN SERVICE

Moscow SOTSIALISTICHESKAYA INDUSTRIYA 3 Oct 86 p 1

[Article by N. Klimov: "Good Luck!"]

[Text] Lipetsk--At the Novolipetsk Metallurgical Combine imeni Yu. V. Andropov, the first phase of the cold-rolled dynamo-steel shop has been put into service a year ahead of schedule. This shop will produce 240,000 tons per year.

The great labor victory of Lipetskstroy and Lipetskmetallurgstroy Trusts and specialized organizations of the USSR Ministry of Installation and Special Construction Work has made it possible to start up the shop ahead of schedule. This has resulted in savings of over 21 million rubles.

The successful construction of this important facility was aided by: 1) excellent engineering preparation for the construction, even during the project-development phase; 2) the implementation of leading construction-installation methods and 3) the heated socialist competition, in which the integrated brigades of M. Inozemtsev and I. Makarov, the installation brigades of G. Melnik and A. Ratnov and many others excelled.

The Lipetsk dynamo-steel shop--the largest in the country--is now contributing to the five-year plan. Good luck!

12595
CSO: 1842/2

WEST-SIBERIAN BLAST FURNACE RENOVATED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 12 Oct 86 p 1

[Article by N. Chulikhin, SOTSIALISTICHESKAYA INDUSTRIYA correspondent: "Blast Furnace Rejuvenated"]

[Text] Today, blast furnace No 3 again was blown in at the West-Siberian Metallurgical Combine. During reconstruction, the old installation was practically completely removed and replaced by a new furnace, complete with the most modern process equipment. This is the first high-volume furnace equipped with mechanisms and instruments to reduce the fines content in the sinter and to intensify the blast process. Overall, this will increase the annual iron production by 100,000 tons.

The collectives of Uraldomnaremont, Sibstalkonstruktsiya and other construction and installation organizations participating in the blast-furnace reconstruction cut the work schedule by 5 days. This made it possible for the West-Siberian blast-furnace workers in 9 months of this year to produce 40,000 tons of above-plan iron and to consolidate their successes in the war for economic acceleration.

12595
CSO: 1842/2

ECONOMIC INCENTIVES NEEDED FOR POLLUTION CONTROL

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 28 Sep 86 p 2

[Article by V. Filippov: "Ecology and Economics"]

> [Text] Zaporozhye--In 1935, the Zaporozhye Titanium-Magnesium Combine produced the country's first industrial magnesium, thus initiating the new sector of nonferrous metallurgy. Twenty years later, the enterprise's shops started producing titanium. Today, the oldest nonferrous-metallurgy plant is on the right flank of scientific-technical progress. The "brain" of calculators and computers is created from the semiconductors it produces. The titanium-magnesium combine is a complicated enterprise, especially from the point of view of environmental protection. Up to three tons of residues are produced for every ton of titanium sponge. Silicon production is even "dirtier": only 10 percent of this element is extracted from the raw material using the existing technology. Our journalist discussed these problems with the combine director, Pavel Nikolayevich Galkin.

"In the future, all our production will be environmentally safe," emphasized the director, "that is the goal of our integrated program for implementing no-waste technology. We expect to reduce all emissions to at least one half by 1990. We understand that any good idea can be realized only on the basis of strictly economic calculations; otherwise, it is just idle daydreaming."

The fact is that the pollution-control devices will be very expensive for the collective. Ecologically clean technologies require considerable additional expenditures, which worsen the enterprise's economic efficiency indicators. Without 15 million rubles worth of pollution-control devices, the combine's yield in capital would rise immediately. Thus, economics itself has become a sore point in nearly all the interrelationships between production and the environment. The decisions of the 27th party congress guide us to the wise use of natural resources. However, today's economics requires that greater profits be derived at minimum expenditures. Furthermore, the economic structure essentially is indifferent to the means by which a goal is achieved. This is the source of the widespread illustion that resource-intensive, polluting industries are highly profitable. This illusion has led more than one economist away from rationality. However,

the storehouse of nature is not bottomless, and the time has come to incorporate the environmental-protection activities of enterprises into the economic cycle, so that the ruble, and not permissible emissions, forces a reduction in the quantity of wastes. Enterprise planning must be changed so that quality and resource-conservation indicators are of principal significance.

"However, the enterprises themselves, not expecting help from the State Planning Committee can significantly lessen the influence of the "scissors" between ecology and economics. For example, by reclaiming resources..."

"True. Without reclamation, no-waste technology is unprofitable. However, this course is also blocked by departmental barriers. The lion's share of wastes from our production are of no value to us, while they might make good-quality raw materials for other enterprises. However, our contacts with these enterprises are hindered, firstly, by the fact that different ministries are involved and, secondly, by the fact that the combine does not have a million tons of tailings. Many environmentally harmful wastes are produced in small quantities. Therefore, it's practically impossible to market these wastes. Only 3000 tons a year? That's just a small-time supplier."

Many enterprises are probably faced with similar problems. These problems might be solved by establishing within the State Committee for Material and Technical Supply a "production-waste bank," where all the "small-time" suppliers could concentate their wastes. It would have two benefits: an additional source of inexpensive raw material and a cleaner environment.

"In recent years, the combine has sharply reduced its water discharge into the Dnepr. Considering that return-water cycles are not cheap, the fact that we have intensively built these facilities cannot be explained by enthusiasm alone..."

"Simply, we began paying for water in the budget. The price of a cubic meter of water is not very high, but if one exceeds the limits, then the rate increases five-fold. Therefore, it was more profitable to build return-water cycles."

By the way, this economic mechanism of evaluating natural resources and paying for allocations of them has not been used enough, in my opinion. Taking into account the present level of environmental-protection technology, enterprises are fully able to pay for air and for land occupied by dumps, just as they pay for water. This will increase the economic incentive for managers to wisely use natural resources.

...A brief intercom signal interrupted our conversation. A. Rekhtman, chief of the environmental-protection department, reported that an inspectorate will be here tomorrow to make a scheduled inspection. He remembered the stack of carbon-copied papers on his desk. He won't have any time to work if he fills them out for each inspector individually. Last year alone, brigades of various environmental inspectorates visited the combine 14 times, spending a total of 65 days and using the help of 112 enterprise workers.

"Fulfilling the instructions of one inspection, we unavoidably violate the requirements of another," noted Pavel Nikolayevich. "In nature, everything is interrelated: water, land and air. We constantly are cutting apart the age-old trinity. First we lean on the air while increasing pollution of the water by residues from the gas scrubbers, then we take care of the water, and then the dumps. This dependence on which inspectorate has the strictest requirements. After all, these inspectorates are 'department-alized': each makes sure 'its own' environmental component is clean."

The "departmental" principle also dominates in the development of pollution-control equipment. We received a cascade-foam absorber from the scientists of the Zaporozhye Titanium Institute. It does a beautiful job of removing hot corrosive gases. But, the equipment designers didn't resolve the problem of what to do with the acidic liquid wastes from the machine.

As soon as we talk about restructuring the interrelationship between production and the environment, I would like to say more thing, without belittling the significance of these inspectorates. It would be wiser to gather all our efforts into a fist: into a single state ecological inspectorate. This inspectorate could make a unified analysis of all aspects of environmental protection and resource-use optimization.

We must not treat the environment like we did before. Then, we were children, and nature, like a mother, fostered us. Now we are adults, and it's time to seriously care for our mother.

12595
CSO: 1842/2

UDC 669.71:537.311.31:536.212:536.483

HIGH PURITY ALUMINUM CRYOCONDUCTOR

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 62, Issue 2, Aug 86 (manuscript received 5 May 85; in final form 10 Nov 85) pp 303-308

[Article by V.I. Gostishchev, Solid State Semiconductor and Physics Institute, Belorussian Academy of Sciences]

[Abstract] A study is made of high purity aluminum as a cryoconductor for operation at liquid hydrogen boiling temperatures. The mechanism of electric and heat transfer in aluminum is studied under the combined influence of deformation and a strong magnetic field at 4.2-40 K. Interaction of the magnetic field with the flowing current, or magnetic pressure, and preliminary tension and linear compression during cooling to low temperatures both influence the mechanical stresses in the windings of electric devices used at low temperatures. The analysis indicates that aluminum cryoconductors can be used in various areas: in devices for cooling liquid hydrogen; in devices with limited weight and dimensions; in magnetic systems with induction in the operating volume greater than that which can be provided by modern superconductors; in various types of cryogenic high current devices; and in hybrid magnets with internal coils operating under severe conditions. References 18: 14 Russian, 4 Western.

6508/9835
CSO: 1842/12

UDC 621.762

STRUCTURE AND FRACTURE OF NICKEL ALUMINIDE POWDER

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 86
(manuscript received 17 Jun 85) pp 97-104

[Article by Yu.L. Krasulin, deceased, S.M. Barinov, M. Shlesar, L. Parilak and Ya. Dusha, Metallurgy Institute, USSR Academy of Sciences]

[Abstract] Methods of fracture mechanics and fractography were used to study the influence of the structure factor on the fracture of materials made of NiAl powder over a broad temperature range. Specimens were made by high temperature sintering and high speed pressing with subsequent heat treatment at temperatures both above and below the secondary recrystallization temperature. The pycnometric density of the sintered materials was 98.3% and that of the high-speed press materials-89.5% to over 99%, depending on the intensity of the thermomechanical effect during pressing. Mechanical testing involved 3-point flexure of 3 X 5 X 45 mm beam specimens at 20-1100°C on an Instron-1115 machine, traverse movement speed $8 \cdot 10^{-6}$ m/sec and vacuum $665 \cdot 10^{-5}$ Pa. NiAl material with recrystallized structure was found to have low strength and crack resistance even at the high densities achieved, as a result of intercrystalline brittleness. Material with aggregate structure had better mechanical properties. Crack resistance in the brittle-tough transition area varied as a function of porosity, which helps to weaken the load-bearing cross section and localize deformation. References 19: 14 Russian, 2 Eastern Europe, 3 Western (1 in Russian translation).

6508/9835
CSO: 1842/15

UDC 669.243.82+669.1.018.2

INFLUENCE OF STRUCTURE OF AUTOCLAVE NICKEL POWDER ON ITS TECHNOLOGICAL CHARACTERISTICS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 12 May 85) pp 10-13

[Article by I.Ye. Gorbunova, Ye.P. Tkachenko and L.N. Yertseva, Gipronike (State Institute for the Design of Nickel Industry Enterprise)]

[Abstract] Gipronikel has developed technological processes for the production of copper, nickel and cobalt powders demonstrating that the autoclave method (reduction of metals from solution by hydrogen at elevated temperature and pressure) allows variation of the properties of the powders over a broad range and the obtaining of products of varying particle size with equiaxial particle shape and well developed surface. A method is suggested

for hydrogen reduction of nickel in autoclaves at 180 ± 5°C, pressure for 3 MPa, from aqueous slurries of basic nickel carbonate in the presence of metallic nickel. The structure of the powder produced was studied by optical microscopy. Porous granules were formed in two stages, with metallic nickel precipitating on the tiny seed grains of independent crystallization centers to form spherical grains to 2 to 10 μm in diameter, followed by conglomeration of micron size metal grains, yielding larger particles with good strength and high porosity. Bulk density and mean nickel content increase with increasing content of compact nickel grains. References 2: both Russian.

6508/9835
CSO: 1842/16

UDC 621.762.5.001:539.4.42:620.18

INFLUENCE OF "INERT" ADDITIVES ON SUPERELASTIC BEHAVIOR OF POWDERED TITANIUM NICKELIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 20 Dec 85) pp 14-19

[Article by S.M. Solonin, I.F. Martynova, V.V. Skorokhod, V.I. Kotenev and I.I. Karpikov, Institute of Problems of Materials Science, Ukrainian Academy of Sciences]

[Abstract] An attempt is made to use "inert" additives to act separately on the structure factor, as well as the strength factor, of compacts and to estimate their influence on superelastic behavior in powdered titanium nickelide. The influence of silicon carbide powder on the structure factor and strength was studied in the process of the compacting of the powders. All of the results indicated that the major factor determining the elastic effect in compacting of titanium nickelide powder is the strength of the compacts, which depends both on porosity and on the bonding strength at the interfaces between particles. The elastic restoration of volume is related to the breaking of interfaces between particles during compacting, and the addition of dispersed powders which weaken the bond strength between particles significantly increases the elastic effect. References 4: 3 Russian, 1 Western.

6508/9835
CSO: 1842/16

DEVELOPMENT AND APPLICATION OF COMPOSITES

Moscow ZNANIYE-SILA in Russian No 9, Sep 86 pp inside cover - p 2

[Article by N. Lazareva "A Few Words on Composites" appears under the rubric "Decisions of the 27th CPSU Congress--Discussions of Technical Progress in Practice;" paragraph identifications that appear vertically alongside paragraphs in the text are given in upper case at the beginning of paragraph]

[Quotation preceding article] "The use of principally new construction materials, developed by our scientists, whose properties greatly exceed those of the presently used materials holds great promise. Specifically, we are referring to composites. Their manufacture will grow by a factor of 10-12 in the 12th five-year plan."

From the report of N. I. Ryzhkov, president of the USSR Council of Ministers, at the 27th CPSU Congress

[Text] Doctor of Technical Sciences Boris Aleksandrovich Arefyev, head of the Composites Laboratory of the Metallurgy Institute imeni A.A. Baykov, USSR Academy of Sciences, tells of a new designing method whose unusual potentialities are not based on complex equipment or on tons of reports and sketches, but on the material itself of the product to be. The journalist, trying to improve the composition [meant to be humorous], cuts into this coversation with the reader from time to time.

B. A. AREFYEV: "Imagine a 'black box' whose input contains complete information about a product, and the output is a ready-made gear."

"What is it made of and how? A computer was given the task, and the computer determined how much material was required and with what properties and, then, computed all its characteristics. The designers with the aid of the same computer calculated the design; and, a flexible production line developed the required material and made the product. Fantastic? No. A nonexisting as yet product made of a nonexisting as yet material may be a controlled system, and we are separated from it not by space, but by time."

JOURNALIST. The given problem is complex: how much material is required and with what properties? Man is accustomed to taking [what is needed], extracting

ore, carving rock, and cutting down trees. Not only is it becoming more difficult to take, but often the required properties are quite special. How should the problem be solved: it is suggested that the material be made up. Making up a material is composition. The sought answer is a composite.

B. A. AREFYEV: "And, the difficulty is not that it is hard to imagine a machine that produces gears, or something more complicated, instead of figures. It will be very hard for the manufacturing engineers and designers to change their attitude, and not only attitude, but to understand the meaning of their work. A manufacturing engineer thinks about the future material, investigates samples, establishes their properties, and enters them into a handbook. The designer, on the other hand, when given a task looks into the handbook and estimates whether this grade of material will suit his needs, and uses it if it does; and, if the material does not suit his needs very well, he will also use it because there is no other material. Certainly, everyone tries to make thins 'in a better way'. However, they do not always think about the fact that the meaning of the words 'better' and 'worse' relates to how suitable a material is for design, which is the thing that must serve man."

"Our problem is to change the traditional attitude toward materials. And, composites will help us in this. The task that the Composites Laboratory received for the current five-year plan is "Metallurgy for Optimal Designs". Methods, calculations, and program packages (collections) for electronic computers--all this remains to be done. Just think, is it possible to use too much metal or have a product of the wrong shape when the material itself and the methods of working with it have been thought through ahead of time by man and machine?"

JOURNALIST. A modern composite may be described as a metal or polymer matrix (base) containing reinforcing fibers, filaments, and particles of quartz sand or gravel. In addition, the composition often contains a number of substances that impart special properties to the composites. These substances may be called inclusions.

To be honest,it is also very tempting for the author to make use of such terminology (don't forget that a journal article is also referred to as material) and to construct an article in the form of a composition from the reasonings of scientists, statements of specialists and,here and there, from one's own "inclusions". As in the case of any composites, there will be a matrix--this, of course, is production, examples of industrial application of composites; and, the statements of scienti ts and scientific ideas will play the role of reinforcement fibers and hard filler.

APPLICATION. Composites based on polymers are light, strong and anticorrosive. They are certainly good for farm machinery. Let us take fiber glass materials as an example. They have served us reliably for a long time. The Minsk Tractor Plant makes the roof of the MTZ-80 tractor cab out of fiber glass. In the near future, similar roofs for harvesting combines will be produced. Heavy machines are known to disturb soil structure and, for this reason, they [designers] are trying to make more parts from light materials.

The experimental scientific-production Plastpolimer Association is developing

composites based on polyolefins. An experimental batch has already entered production, and sheets have been made from this composite at the Nelidovo Plastics Plant. Plow moldboards will be manufactured from these sheets; the material is strong, wear-resistant, and soil does not stick to it (because of the polymers).

The Plastpolimer Association together with specialists of the plant-VTUZ at Rosselmash is engaged in selecting materials for the new Don-1500 combine. The development of a machine made of materials still unknown under working conditions is a very complex problem and the collaboration of the developers with the producers is quite understandable.

Drain pipes are so essential in sovkhozes! Filled polymers (polyethylene with chalk or microlimestone) are used instead of metal. Pipes also require joints and welding equipment. Therefore, all irrigation system parts and materials have to be completely thought through ahead of time.

B. A. AREFYEV: "The collaboration of an institute with an enterprise, if we can put it this way, must be planned and progressive. Primarily, this is good operational 'feedback', information facilities, and electronic computers."

"What is our 'black box'? It will operate if we provide two 'positions' and one flexible production line. The first position is an automated production engineer work place (let's say a designer of materials). One should not think that this is simply a matter of sitting in a swivel chair. Seriously speaking, this involves a computer, a package of programs for it and well coordinated peripheral equipment: magnetic disks and tapes, graphic displays, graph plotters and, of course, duplicating equipment. The second position is also a designer position. A product engineer and designer work constantly cooperating with each other because they have the same task--to develop the best variant of a product by using the best feasible method."

V. A. TOCHIN: "From the experience already available I can draw the conclusion: using a computer in the development of new materials, I can say it is not some auxiliary device or some prestigious plaything, and even not an accessory to machines, but a piece of essential operational equipment; one can say that the computer itself produces the product. There is no doubt that synthesis takes place in a reactor, the press presses, and the computer under man's control undertakes the most laborious and most tedious work: it reconstructs all the details of a future product from fragments, and builds an information model."

"At the institute we are already preparing a package of programs for designing materials which have been ordered by enterprises. It would be ideal to work with a personal computer, actually this is the only way one should work. This is so because the designing of materials for a real product is really a preimage of information technology.

JOURNALIST. The material designers unanimously maintain that a product must be developed parallel to the material itself. In the fifth issue of our journal for 1986 in the article "Generation No..." we tried to trace the relationship between new products, technology of material manufacture, and the equipment servicing production, using the present state of the reinforced concrete construction

industry as an example. Three rung positions were found: new products were on the highest rung, material technology was on the middle rung and, unfortunately, equipment was lagging--it was on the lowest rung.

And, what about composites? Design and material are side by side, and the flexible production line is rearranged in the planning process. Here, we have a straight line: none of the components lag behind, all of them march together.

But, no matter how well this looked in theory, the person who had to contact the manufacturing enterprises, would say the following:

APPLICATION. It is difficult dealing with customers...All were told: we need an order with a complete description of the proposed design. However, the customer, strangely enough, does not always know what he really needs. We advertise a new material and, then, are asked to deliver an experimental batch. They try it out at the enterprise--it seems to be rather satisfactory, but they continue to manufacture their product in the same old way and claim that it is cheaper to produce with the traditional materials. It is true that a composite that is made in small batches is expensive and, therefore, the price is higher. A subsidy system is needed, then assimilation will be simplified. And, when production will be produced in series, the technological cycles will be established and the price will drop. New materials also require new organizational decisions. In addition, the customer should know exactly with what he is dealing.

JOURNALIST. The customer perhaps will not guess..., but people essentially have been using composites from ancient times. There is someone who first built an adobe house by mixing straw with clay and different waste materials. It was strong. In ancient Babylon clay was combined with rush, and in Greece (also, ancient) iron rods were inserted into marble columns. And, in the construction of St. Basil Cathedral in Moscow a complex material was used--stone slabs reinforced with iron.

SCIENTISTS. B. A. AREFYEV: "And, when did the term 'composites' appear?"(This question Boris Aleksandrovich asks himself, thinks for a while, and then recalls the details and dates).

"Probably, from the moment that it was learned that the strength of a material, for example aluminum, reinforced with carbon, exceeds the strength of standard aluminum by a factor of ten. Composites are divided into three groups: powdered (dispersion), laminated and fibrous. You will meet many old friends among these. Laminated--ordinary veneer which is well known and bimetals, used in electric circuits; powdered--produced by powder metallurgy methods and many plastics and polymers with fillers; fibrous--fiber glass, carbon plastic and metals, reinforced with various fibers. Reinforced concrete is also a composite. Thus, people have tried to develop a metal with an 'ideal nature' by combining the properties of a matrix (the same concrete, polymer or metal) with the properties of a filler (fibers or iron rods, sand). It is very important how the components are combined. Macaroni prepared navy style is a mixture. But, kozenaki [Caucasian lamb stew] is a composite. One can simply mix, dry, bake, and press, but one can also go into the compound even deeper and get down to the molecular level."

JOURNALIST. For example, norplasts [norplasty in Russian] are well known. If we break up the word "norplast" into its components, then we get a whole phrase: filled organic plastics". These inexpensive, strong, and simple to produce composites were first developed at the Institute of Chemical Physics, USSR Academy of Sciences. They were first developed there under the leadership of Academician N. S. Yenikolopov. Regular quartz sand filler was taken, treated with a catalyst, had ethylene gas passed through its mass and then was sent to a synthesizer. The gas was polymerized and this strongly bound the sand particles, thereby forming polymer macromolecules directly on the sand grain surfaces. This resulted in producing exceedingly high values for hardness, strength and wear-resistance (the wear-resistance exceeds that of high-molecular polyethylene by a factor of five, and sometimes ten).The norplasts acquired from the polymers a low coefficient of friction, resistance to active substances as well as a slippery surface, to which for example clay does not stick. This property (antiadhesiveness) proved to be very important.

APPLICATION. Some types of composites have already been discussed. It should be emphasized once more that composites are light and strong. So, where else should we look for potentialities of their application? In the aircraft industry, of course. For the first time in 1957, the blades of an aircraft lift engine were made of fiber glass. By the seventies, a rather large quantity of aircraft parts (about 30 percent of the exterior surface) was made of fiber glass. Then, a certain disillusionment appeared. The fiber glass materials did not prove to be strong enough. Composites have significantly squeezed out metals used for aircraft wings with the appearance of materials reinforced with carbon fibers and of so-called hybrids--carbokevlar [uglekevlar in Russian] plastics. Organic fibers made of aromatic polyamides of the kevlar type are very strong, nonfusible and do not sustain combustion. In addition to carbon and kevlar fibers, fibers made of glass and boron, as well as well as beryllium and steel wire, are used. The following metals may serve as a matrix: aluminum, titanium, nickel and, of course, polymers.

It has been calculated that the mass of a transport aircraft may be reduced from 210 to 150 tons with the use of composites. Then, the thrust of one engine will be reduced from thirty to twenty-five tons, and considerably less fuel will be needed. For example, eighty percent of the wings and empennage of an aircraft may be made of composites! The reinforcing fibers bear the basic part of the load. It is important that they be arranged in the direction of the forces. So far, unfortunately, this is very labor-intensive work and much time and effort are spent on it in wing assembly.

In modern helicopters, the most critical part--the rotor--is made of fiber glass, and the fuselage components are basically made of kevlar plastic. It was said in one of the reports at the 5th All-Union Conference on the Mechanics of Polymer and Composite Materials that: "We can predict with certain probability that the first transport aircraft, completely made of composites, will be flying before the year 2000."

JOURNALIST. There is the age-long desire to develop unusual properties: "does not burn in fire, and does not sink in water". They, of course, were speaking about componors. It is true that they still conduct heat and electric

current, and they may become magnetic. Here, before you are products made of materials known as componors [komponor in Russian]: several black plates, a bundle of dark brown rings of small diameter, a yellow cylinder with holes, and a non-shiny radiator box.

APPLICATION. Let us explain: these brown little rings are simply centering and reducing magnets for television tubes. Rings of this type were made of magnetic powder up to this time. With sintering of the powder the rings were often of an irregular shape and cracked during machining. We suggested a polymer matrix with a magnetic filler. The rings are cast and require no machining. Presently, magnetic rings made of componor are used in Rekord color television sets. Componors can also conduct electric current and even replace electrical fireplaces. The black shiny plates on the table are made of polymer with ordinary carbon black and carbon black is an electroconductive substance. If you cover the floor with such plates and connect the electricity, your building will be comfortably heated. These plates are made to order for the All-Union Scientific Research Institute of Electrotechnical Equipment (VNIIETO) to be used in livestock complexes of localities near Moscow. Componors of this type already keep newborn piglets warm. By the way, these black plates may be used to make, for example, a balcony cooler, a sort of "cellar" on the balcony; a temperature of slightly over zero is very convenient for storing vegetables and pickled foods. Try to imagine a temporary shelter or tent made of such a componor: you connect the wall to a storage battery and you can keep yourself warm.

Componors are quite often used in place of aluminum: they are as light and strong, but are considerably cheaper. Now, this bobbin (the yellow cylinder with the holes) is used in industry for winding synthetic fibers, and strong spools are also made of a composite for textile workers.

JOURNALIST. Actually, the properties of modern composites are extremely varied because people are making these synthetic materials according to the demands of time.

Time, as always, makes us think about generations. Composites were born, so to speak in very ancient times, but we have to start not with Babylon but with fiber glass and glass cloth. They appeared in the forties and fifties and are serving the construction industry well to this very day. The first materials reinforced with thread-like crystals of boron and carbon were developed in the sixties. It was just at that time that experiments were first conducted to grow thread-like elongated crystals from these elements and combine them with a polymer or metal matrix. The results for strength were so excellent that it became clear: composites are serious competitors of metals. In this way, a second generation appeared. And the third generation in the seventies and eighties is related to the development of new high-strength fibers from the same boron and carbon as well as organic silicon compounds and aluminum oxides. Other directions were actively developed in those years; specifically, it was then that norplasts appeared.

And, of course, now a new generation--the fourth--is approaching. It is related to the widespread, general application of composites and to the new, inexpensive technologies of their production. The advent of the fourth generation must be accelerated and here good organization is important.

APPLICATION. Summing up what has been said, I wish to emphasize: widespread informational work is needed. Filled polymers are also being developed and produced at many enterprises; a tremendous amount of time and money is being spent, and the outcome is the "reinvention of the wheel". A single planning organization for these operations and a head enterprise for coordinating all operations are essential. A data base for polymer composites has to be established that is available to developers in all corners of our country.

And, at the level of an industrial institute or scientific production association, the question is how should the responsibilities between an enterprise and an institute be allocated in practice?

It was found that it is more convenient and more reasonable to develop and assimilate composites "according to advance orders". This included the composites that were high-strength, thermo- and electroconductive, magnetic, fire-resistant and those that had highly diverse combinations of these properties. Here [at the institute level], only development, testing of industrial technology, output of experimental batches, recommendations for assmilation, and consultations on setting up production lines take place. Both the materials and products will be produced in series by the enterprises themselves.

JOURNALIST. In this brief discussion of composites, we touched on scientific developments and experimental production samples, however, this is only a small part of the problem. The reconstruction of the Kuskov Chemical Plant still has not been completed, and there is not enough floor space to set up the equipment. For these reasons and for probably many more, the needed materials are still not being produced in sufficient quantitites, and this is a pity. There is so much that can be made and should be made of composites: various machine and mechanism parts, drain pipes, textile industry equipment, communication cable ducts, all types of packing, many household items, toys and even furniture. And, in the near future--automobile bodies, engine parts, drilling equipment, washing machines, bicycles and others.

12525
CSO: 1842/4

PRODUCTION OF IMPROVED REFRACTORY BEGINS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 Sep 86 p 1

[Article by V. Semenov, SOTSIALISTICHESKAYA INDUSTRIYA correspondent: "Ural Refractories"]

[Text] Pervouralsk, Sverdlovsk Oblast--The Urals Thermal-Insulation Plant of Uralenergopromstroy Association has produced its first lot of fiberglass refractory. A production line has been started up here to produce a more heat-resistant thermal insulation. The new material can withstand temperatures of up to 1200 degrees, twice the temperature of the previous insulation. By the end of the year, customers will have received over 100 tons of efficient refractory. The output of this material will be constantly increased. Two more lines are to be built at the plant.

12595
CSO: 1842/2

UDC 669.822:621.318.1

NEW GROUP OF URANIUM MAGNETIC MATERIALS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 62, Issue 2, Aug 86 (manuscript received 9 Jul 85) pp 266-268

[Article by A.V. Andreyev and M.I. Bartashevich, Urals State University imeni A.M. Gorkiy]

[Abstract] A study is made of UMT uranium alloys, were M is an element of group 3 or group 4, particularly Al, Ga, In or Sn, at T is a transition metal from the iron, palladium, platinum triad. It is found that there is a large group of isostructural uranium magnetic materials among these alloys. The alloys were produced in an arc electric furnace on a copper wire cooled base in an atmosphere of helium. Phase analysis was performed by x-ray studies of powder specimens. Temperature and field variations of magnetic moments were studied in a vibromagnetometer in static fields of up to 2 MA/m and by induction in pulsed fields of up to 10 MA/m at 4.2-300 K. Magnetic properties were studied on polycrystalline specimens with a high degree of unaxial texture. This new, large group of uranium magnetic materials has a simple crystalline structure. Systematic study of the new group of materials should be quite interesting for development of knowledge on the magnetism of actinides. References 7: 4 Russian, 3 Western.

6508/9835
CSO: 1842/12

UDC 669.3'862:541.65

OPTICAL PROPERTIES OF THE COMPOUND GdCu

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 62, Issue 2, Aug 86 (manuscript received 11 Feb 85; in final form 20 Sep 85) pp 279-283

[Article by L.V. Nomerovannaya, N.A. Popova and R.S. Torchinova, Metal Physics Institute, Ural Science Center, USSR Academy of Sciences]

[Abstract] A study is made of the optical properties of the intermetallic compound GdCu in the paramagnetic and antiferromagnetic states in order to study its electron structure, as well as the restructuring of the electron energy spectrum upon transition through the magnetic ordering temperature. The study of the optical properties of GdCu reveals stability of the energy position of structural specifics on the curve $\sigma(\omega)$ upon transition to the antiferromagnetic state, with the exception of slight changes in the 0.5-0.9 eV spectral area: a decrease in intensity and clear resolution of peaks at 0.65 and 0.80 eV. This behavior of optical absorption in GdCu upon transition through the magnetic ordering point is opposite to the behavior of pure rare earth metals. References 11: 3 Russian, 8 Western.

6508/9835
CSO: 1842/12

UDC 542.65:539.216.2

ZONE RECRYSTALLIZATION OF SILICON FILMS ON FUSED QUARTZ

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86 (manuscript received 27 Nov 84) pp 1413-1416

[Article by A.B. Limanov, Ye.I. Givargizov and V.N. Zemskiy, Crystallography Institute imeni A.V. Shubnikov, USSR Academy of Sciences]

[Abstract] Results are presented from studies of zone recrystallization of thin silicon films on fused quartz. The high melting point of fused quartz allows significant overheating of the melting zone, and is resistant to warping which may occur in zone melting at high temperature gradients. The stability of the melted silicon zone was found to depend on the kinetics of heating. Rapid increases in radiation power produced a homogeneous zone. The central portion of the zone moved smoothly. The crystallization front was a nearly straight line which also moved smoothly. The recrystallization film consisted of large grains up to 2 mm wide, extended in the direction of movement of the zone by several centimeters. Development of substructure could not be completely avoided, in spite of the high temperature gradients. Orderly formation of the substructure requires the use of moderate temperature gradients, which can be achieved by increasing

the overall temperature of the substrate or the formation of a narrower melted strip by the use of a more resistant protective film.
References 6: all Western.

6508/9835
CSO: 1842/13

UDC 546.681'193

INTERACTION OF GOLD EVAPORATED IN A VACUUM WITH A SURFACE LAYER OF GALLIUM ARSENIDE

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86 (manuscript received 3 Dec 84) pp 1421-1424

[Article by T.A. Bryantseva, G.G. Dvoryankina, Z.M. Lebedeva, A.G. Petrov, Ye.B. Sokolova and Ye.O. Yunevich, Radio Engineering and Electronics Insittute, USSR Academy of Sciences]

[Abstract] Methods of electron Auger spectroscopy and electronography are used to study the structure and composition of a surface film of gold applied to the (100) surface of GaAs single crystal plates. The gold films were precipitated by thermal evaporation in a vacuum. The maximum temperature of the substrate was about 353 K and precipitation rate about 0.3-0.5 nm/sec. The Auger spectra were taken at room temperature. It was found that when gold films were precipitated onto the GaAs surface by thermal evaporation under a vacuum, chemical breakdown of the semiconductor surface occurred, in the form of fracture and separation of a thin surface layer with formation of new chemical compounds. These processes apparently result largely from the fact that the thermally evaporated gold is a slightly ionized gas.
References 7: 1 Russian, 6 Western (1 in Russian translation).

6508/9835
CSO: 1842/13

UDC 66.863:538.214

PRODUCTION AND MAGNETIC PROPERTIES OF TELLURIUM-CONTAINING DICHROME-CADMIUM TETRASELENIDE

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86 (manuscript received 10 Dec 84) pp 1435-1437

[Article by N.D. Zhilyayeva, A.S. Borukhovich and V.G. Bamburov, Chemistry Institute, Ural Science Center, USSR Academy of Sciences]

[Abstract] Single-phase solid solutions of $CdCr_2(Se_{4-x}Te_x)$ were obtained by a pulse technology including preliminary synthesis of chromium chalcogenides which were sintered with intermediate briquetting at 900°C for about 100 hours. The results indicated that single-phase solid solutions with normal spinel structure can be obtained at concentration limits of $0<x\leq0.3$. Where $x\geq0.3$, the solid solutions produced are two-phased, the second phase being dichrome triselenide Cr_2Se_3 with slightly altered until cell parameter. The solid solutions obtained may have a decrease in effective degree of nonstoichiometry in comparison to the anion-defective initial spinel, leading to an increase in spontaneous magnetism and ferromagnetic moment of the specimens. References 5: 3 Russian, 2 Western.

6508/9835
CSO: 1842/13

UDC 546.273.171:543.422.27

STUDY OF PYROLYTIC BORON NITRIDE BY ELECTRON PARAMAGNETIC RESONANCE

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86 (manuscript received 3 Dec 84) pp 1457-1458

[Article by A.V. Shendrik, Ye.A. Tomiltsev and L.V. Kozlovskiy, Leningrad Institute of Technology imeni Lensovet]

[Abstract] Methods of x-ray phase analysis, IR spectroscopy and electron paramagnetic resonance (EPR) were used to study the structural changes occurring in pyrolytic boron nitride upon heat treatment. The structural changes in the material were found to be greatly influenced by heat treatment conditions. After annealing at 1000°C for 1 hr in an atmosphere of argon, the EPR signal belonging to amorphous boron is observed, the intensity of which decreases with increasing temperature. After annealing at 1700°C for 1 hour, the signal from amorphous boron is absent. A reaction apparently occurs under these conditions between the amorphous boron formed as a result of partial decomposition of the pyrolytic boron nitride and molybdenum, which is confirmed by x-ray phase analysis indicating the

presence of MoB and MoB_2. Heat treatment in both nitrogen and argon causes partial decomposition of the pyrolytic boron nitride, forming amorphous boron and increasing the concentration of F-center defects. References 4: 3 Russian, 1 Western.

6508/9835
CSO: 1842/13

UDC 546.77+677.4

INFLUENCE OF HEAT TREATMENT CONDITIONS ON STATUS OF MOLYBDENUM IN MOLYBDENUM-CARBON FIBERS

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86 (manuscript received 10 Dec 84) pp 1466-1470

[Article by I.N. Yermolenko, N.V. Gulko and I.P. Lyubliner, General and Inorganic Chemistry, Belorussian Academy of Sciences]

[Abstract] Results are presented from studies of changes in the status of molybdenum in molybdenum-carbon fiber in the process of their production from hydrated cellulose fibers with ammonium paramolybdate added as a function of heat treatment temperature and composition of the gas medium in which heat treatment is performed. It is found that increasing the heat treatment temperature from 770 to 1170 K results in a transition of the x-ray-amorphous molybdenum trioxide to crystalline molybdenum dioxide. Decreasing the heating rate and performing heat treatment without evacuation of volatile products facilitates the formation of the Mo_2C phase. When heat treatment is performed at 1070-1170 K, the molybdenum-carbon fiber contains x-ray-amorphous elementary molybdenum. References 7: 4 Russian, 3 Western (1 in Russian translation).

6508/9835
CSO: 1842/13

UDC 535.34

STRUCTURE AND CERTAIN OPTICAL PROPERTIES OF Pr_6O_{11} FILMS

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86
(manuscript received 3 Dec 84) pp 1475-1479

[Article by A.F. Andreyeva, I.Ya. Gilman and M.Ya. Gamarnik, Institute of Material Science Problems, Ukrainian Academy of Sciences]

[Abstract] This article studies the interaction between the structural perfection and optical parameters of films of Pr_6O_{11} obtained by oxidation of a metal mirror. X-ray analysis indicated that the phase composition of condensates oxidized in air at 350-500°C was independent of the precipitation rate and substrate temperature in the process of precipitation of metallic Pr, or rate or time of heat treatment of the precipitated condensates in air. The influence of the degree of ordering of the structure and dimensions of areas of coherent scattering on the reflection and optical density of the Pr_6O_{11} films produced was investigated. It was found that the reflection of the condensates depends to a greater degree on the disordering of the structure than on the dimensions of the crystals. No clear variation was observed between the crystal size, coefficient of reflection and optical density of the condensates. References 3: 2 Russian, 1 Western (in Russian translation).

6508/9835
CSO: 1842/13

UDC 620.193.013:546.321

PHOTOPOLARIZATION OF THIN OXIDE COATINGS ON TITANIUM

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86
(manuscript received 5 Nov 84) pp 1480-1482

[Article by P.S. Gordiyenko, S.V. Gnedenkov, A.V. Yefimenko, V.Ya. Shevchenko and O.A. Khrisanfova, Chemistry Institute, Far Eastern Science Center, USSR Academy of Sciences]

[Abstract] Photocurrent was recorded as a function of time during irradiation of anode oxide films of varying thickness on titanium. Specimens were irradiated in the area of the band of fundamental absorption with filtered light from a mercury lamp. Specimens of varying thickness obtained by anodic oxidation of Ti in an Na_3PO_4 electrolyte with a current density of 30 mA/cm^2 were placed in sequence in an electrolytic quartz cuvette with the same electrolyte. The comparison electrode used was similar to the specimen studied but was covered with a light-protective shield to avoid the contribution of the electrochemical potential to the photosignal. The study of the oxide films was used to reveal the diffusion

length of charge carriers in the material studied. Scanning of the light beam over the surface of the specimen allowed determination of inclusions of other compositions on the surface. References 8: 6 Russian, 2 East European.

6508/9835
CSO: 1842/13

UDC 537.228.1:541.67

PIEZOELECTRIC PROPERTIES OF $(Pb_{1-x}Ba_x)_2NaNb_5O_{15}$ CERAMIC EXPOSED TO PRESSURE IN THE DIRECTION OF POLARIZATION

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86 (manuscript received 10 Dec 84) pp 1516-1519

[Article by S.S. Lopatin, B.S. Medvedev, Yu.N. Biyatenko and N.I. Basenko, Rostov State University imeni M.A. Suslov]

[Abstract] A study of the piezoelectric properties of a $(Pb_{1-x}Ba_x)_2NaNb_5O_{15}$ solid solution ceramic is presented as well as an investigation of the specifics of its depolarization when exposed to uniaxial pressure. All specimens with x between 0 and 0.31 and between 0.45 and 1 were single-phase specimens, a rhombic solid solution based on $Pb_2NaNb_5O_{15}$ with polar direction [010] in the former case, a rhombic solid solution based on $Ba_2NaNb_5O_{15}$ with polar direction [001] in the latter case. With x between 0.31 and 0.45, the ceramic was a mixture of the two phases. Processes of polarization and depolarization at 380MPa were studied. It was found that the values of the irreversible and reversible changes in the piezo-electric modulus caused by pressure in the direction of polarization are determined by the phase composition of the ceramic. The greatest irreversible changes (about 55%) were observed in the morphotropic area with x between 0.33 and 0.43, which is related to the 90° disorientation of phase domains with polar direction [010] and the transitions between the two phases. References 4: 2 Russian, 2 Western (1 in Russian translation).

6508/9835
CSO: 1842/13

UDC 666.11.01

DIELECTRIC AND OPTICAL PROPERTIES OF GLASSES IN THE SYSTEM $CdO-B_2O_3$

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 22, No 9, Sep 86
(manuscript received 13 Dec 84) pp 1552-1554

[Article by V.N. Semin, V.T. Maltsev and A.Ye. Panich, Rostov Construction Engineering Institute]

[Abstract] This article is intended to supplement available information on the physical and chemical characteristics of cadmium-borate glass, synthesized using PbO, CdO and B_2O_3 in alundum crucibles at 1237 K, 1 hour, then poured onto stainless steel plates. It was found that changing the composition of the glasses produced changes in structures similar to those occurring in lead-borate glasses. The maximum fraction of boron atoms in the tetrahedral coordination with respect to oxygen was observed at $CdO:B_2O_3 = 3:2$. References 6: 5 Russian, 1 Western.

6508/9835
CSO: 1842/13

UDC 666.76.01+621.48

INFLUENCE OF OXIDATION IN THE PRESENCE OF SALTS ON STRENGTH OF SILICON-NITRIDE-BASED CERAMIC

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 3 Feb 86) pp 53-57

[Article by G.A. Gogotsi, Yu.G. Gogotsi, A.V. Drozdov and O.D. Shcherbina, Strength Problems Institute, Ukrainian Academy of Sciences; Institute of Materials Science Problems, Ukrainian Academy of Sciences]

[Abstract] A study is made of the influence of oxidation in the presence of sodium chloride and sulfate, sea salt and an equimolar mixture of Na_2SO_4 and V_2O_5 on the strength at 20 and 1200°C of NKKKM-84 corrosion-resistant boron-containing ceramic. Treatment with the salt solutions with subsequent oxidation resulted in reduced strength at 20 and 1200°C. The decrease in strength at room temperature resulted from the formation of an oxide layer containing many defects. High temperature strength of specimens treated with Na_2SO_4 and $Na_2SO_4-V_2O_5$ dropped particularly sharply, a result of the active interaction of these compounds with silicon carbide. References 11: 7 Russian, 4 Western.

6508/9835
CSO: 1842/16

PRODUCTION OF METALLIC MONOCRYSTALS DESCRIBED

Moscow KHIMIYA I ZHIZN in Russian No 5, May 86 pp 2-7

[Article by A.I. Manokhin, correspondent member of the USSR Academy of Sciences, and G.S. Burkhanov, doctor of technical sciences, Institute of Metallurgy imeni A.A. Baykov, USSR Academy of Sciences: "Resources: Metal In Monocrystalline Form"]

[Text] Everyone generally has their own ideas about the metals that they constantly encounter in everyday life and in industry and about their basic properties and uses in various mechanisms and everyday utensils. However, in everyday life, we deal with ordinary (polycrystalline) metals of industrial-grade purity. Highly-pure monocrystalline metals are something else entirely. Sometimes the changes are so pronounced that the old and familiar materials suddenly seem completely new.

Therefore, molybdenum and tungsten are brittle at room temperature but in their pure monocrystalline form, they become highly plastic and stay that way even at the temperature of liquid nitrogen (-196°C). In their fibrous form, the "whiskers" of many metals show a strength greatly exceeding (by scores of times) their actual strength and reaching theoretical values and, as we know, this is a phenomenon determined by the forces of interatomic adhesion.

As opposed to polycrystalline metals of ordinary industrial purity, monocrystalline metals show a high degree of anisotropy: the magnitude of a given parameter can can differ greatly in relation to the orientation taken by the crystal. Is this good or bad? As a thing in itself, it is neither. The task of metallurgists and users of monocrystalline materials is to know when a crystalline form is useful and how to use it.

Throughout the world, the interest in monocrystalline metals of high purity is growing and these materials are gaining an important role in leading fields of technology. It has become obvious that thorough removal of impurities and production of monocrystals is an effective means of creating metal structures with certain properties.

We will discuss these materials, how they are produced and their uses.

Relative Perfection

If we place a drop of a saturated aqueous solution of table salt or some other salt, one can with slight supercooling observe the crystallization process. The crystallization starts at the edges of the drop from which the points of the individual dendritic crystals work their way inward.

A metallic melt poured into a mold or specially prepared form crystallizes in the same way. The dendritic nature of crystallization can be either reinforced or suppressed by changing the amount of impurities and the crystallization conditions. As more and more crystallization centers (nuclei) are formed and crystals grow, the amount of melt will be reduced and the entire space gradually filled with the solid phase consisting of separate grains. The boundaries between the grains are very distinct in a metallographic microscope (under reflected light).

The polycrystalline structure of a metal reminds one of a honeycomb. A cubic centimeter of such metal can contain several million grains. As a rule, the boundaries between these grains contain all types of impurities and this may cause brittleness. Thus, it appears that one has to think not only of chemical purity but also of the perfection of the crystalline structure.

When it solidifies, a polycrystalline conglomerate usually produces a multitude of crystal nuclei, each of which is capable of growing. However, one can select the sort of crystallization conditions that growth can proceed from that only one type of crystal can grow from one nucleus and suppress the growth of other forms. In this case, the solidified metal is a monocrystalline form without the inter-grain boundaries and their impurities. This process is what gives such a material its high degree of plasticity that is so technologically desirable and also makes it so difficult to produce such metals.

Here it would be proper to remind readers that different metals may possess differently constructed crystalline lattices such as body-centered cubic (in all alkaline and alkaline-earth metals as well as vanadium, tungsten, molybdenum, niobium, tantalum and chrome), face-centered cubic (aluminum, copper, silver, gold, lead, strontium and serveral other metals), hexagonal densely-packed (magnesium, beryllium, rhenium and part of the platinoids)..In addition, while solidifying, many metals undergo polymorphic transformations in which it is chiefly their crystalline structure that changes.

Here I would like to mention the different types of defects peculiar to crystallized metals. Ideally speaking, a metal crystal consists of positive ions forming a lattice of some configuration and about the same number of shared electrons. There is an enormous number of positive ions and shared

electrons, about 10^{22}-10^{23} per cubic centimeter. The ions oscillate around equilibrium positions known as the crystal's lattice points.

However, this is only the ideal crystal because in real crystals there are many defects. These are atoms of impurities that may vary greatly in size and distort the crystal lattice. Aside from foreign atoms of this sort, there are also be disruptions in the order of arrangement of the ions as well as vacancies that are for some reason not taken by ions. At the same time, there can also be inter-lattice points that are "overloaded" with ions. When the metal approaches its melting point, the concentration of vacancies can reach one percent or more. This means that every cubic centimeter of a crystal may contain 10^{21} vacanies which is 10 times the number of molecules found in the same volume of air at atmospheric pressure.

There are point defects and linear defects known as dislocations. Under an electron microscope, they are seen as separate fibers or webs of such fibers. The crystal lattice around such a dislocation is strongly distorted. The diameter of the distorted region (nucleus of dislocation) is 5-7 times the size of an atom and its length may reach many thousands of interatomic intervals.

Aside from point and linear defects in monocrystals, one also finds two-dimensional defects, an example of which is the boundary of blocks which are regions (crystallites) that are rotated slightly toward one another and into which the entire volume of the crystal is divided. The linear dimensions of such blocks can range from 10^{-5} to 10^{-2} cm. The crystalline structure within each block is closer to ideal than within the monocrystal as a whole.

Two-dimensional defects can be considered the freest surface. As a rule, more crystalline defects are found here than in the monocrystal as a whole and the adsorption of atoms from the atmosphere always affects chemical purity. The sciences of physics, chemistry and technology are striving to reduce to the lowest possible level the number of impurities and crystalline defects. Why?

Specimens of the highest physical and chemical purity are used today to determine the constant values of elements. Very pure metals contain no less than 99.999 percent of their primary substance. KHIMIYA I ZHIZN has often discussed such materials (as in issue No 8 of 1985 about extra pure aluminum). Nevertheless, we will add some other examples of transforming purity.

The chief metal of modern technology is iron of three 9's or more purity which maintains its plasticity at the temperature of liquid nitrogen (-196°C). Industrial-grade iron (one 9 after the decimal point) becomes brittle at just -40°C.

For uranium, another of today's important metals, the melting point is 1133°C. Before it was possible to produce uranium of the required purity, this technologically important constant differed from the true by as much as several hundred degrees!

Still another technically important characteristic of a metal is the temperature at which growth of new crystals in the body of the deformed metal begins due to the transition of atoms from crystallites distorted by deformation to undistorted and thermodynamically stabler ones. Industrial grade aluminum (99.7 percent pure) begins to recrystallize at 250°C while extra-pure (99.999 percent) begins to do so at -50°C! This means that parts of complex shape can be stamped or rolled from extra-pure aluminum without preheating and subsequent heat treatment.

The importance of purity not only regarding impurities but also regarding crystallographic defects is great. The clearest example of the effect that such purity has on the properties of a metal can be found in the phenomenal strength of the previously-mentioned "whiskers", undislocated fibrous monocrystals of 0.001 to 1-2 microns in diameter and 10-12 mm in length. Fibrous monocrystals of iron, copper and zinc are 10-15 times stronger than ordinary polycrystals. Furthermore, highly-pure metals in the form of monocrystals are more erosion resistant, have greater creep resistance (especially at temperatures close to the melting point) and resistance to heat and radiation.

However, in all cases and for all metals, no two impurities are alike. There are very harmful impurities and those that are extraordinarily useful for certain mechanical, optical and electrical properties. The same can be said of crystalline defects: their type, concentration and relative positions determine many different physical properties. It is obvious that it will be possible in the near future to produce metallic monocrystals with a measured content of admixtures and crystalline defects. This would be a completely new class of materials with a wide spectrum of physical, chemical and other useful properties. What we already have is only the beginning.

How to Produce Metallic Monocrystals

There are many methods. The chief one is zone melting in its various forms but it must be remembered how closely connected the problems of producing monocrystalline metals are with extra-purification of substances.

Without extra-pure materials, it is impossible to produce monocrystals of the required perfection of crystalline structure. The methods for producing metallic monocrystals are usually combined with various methods of chemical purification. These are sublimation and liquid extraction, ionic exchange and dissociation of haloid compounds, electrolysis and vacuum smelting. Purification also occurs directly during the growth of a monocrystal as the result of the evaporation of impurities or when the moving crystallization front pushes them toward the end of the ingot.

If the beginning solid phase is a seed monocrystal, then the accumulating atoms sequentially, layer by layer, build on its crystalline lattice, precisely repeating every nuance of the crystalline structure of the seed. The crystalline defects mentioned earlier could occur as the result of fluctuations in the composition and conditions of crystallization, which must be maintained as

strictly as possible, and can also "grow" from the seed due to its imperfections. Hence the very strict requirements on the seed crystals and the need for their careful "inspection" and selection prior to the beginning of the process.

Undesirable impurities can be introduced by the material of the apparatus or the air of the environment. That is what has necessitated the use of protective atmospheres and strict requirements on the materials used in the crucibles as well as the creation of crucible-free methods of growing monocrystals. Therefore, in the production of monocrystals of high-melting metals (tungsten, molybdenum, rhenium and tantalum), a crucible-free variant of zone melting is used in a deep vacuum. The narrow zone, melted by electron beam, is confined by surface tension and and moves down the starting billet along with the tungsten ring cathode which also serves as an electron source.

It is essential that in producing a monocrystal with a given crystallographic orientation (such as anisotropy), the liquid zone is first created at the point at which the seed monocrystal and the polycrystalline billet join. An important achievement in the cultivation of monocrystals from high-melting metals was the use of plasma-jet heating. The plasma-arc method was used to produce massive (as large as 50 mm wide) monocrystals of tungsten and molybdenum. In comparison with electron-beam zone melting, this method is several times faster and the monocrystals produced are also chemically purer.

A Little About Analysis

In order to produce highly-pure metallic monocrystals and more important, that they be of real use as industrial materials, it was necessary to learn how to control their quality. One such method that is fairly well-known and simple was comparative evaluation of the electrical resistivity of samples at room temperature and the temperature of liquid helium ($4.2^{\circ}K$). The specific resistivity at the temperature of liquid helium characterizes well enough the content of both the chemical impurities as well as crystalline defects. Its magnitude is inversely proportional to the mean path of the electron in the period between its two collisions with atoms of the impurity. The use of relative rather than absolute values excludes the geometric factor which, if you remember, is part of determining the specific resistivity. The magnitude of this ratio says much about the physical and chemical purity of metallic monocrystals.

Such uncommon materials can be analyzed by traditional mass-spectrographic methods, nuclear-physical methods and by electron-microscopy. We will not discuss these methods any further because they have all been described numerous times in KHIMIYA I ZHIZN.

Where Are Monocrystals Used Today?

Not monocrystals in general but metal monocrystals.

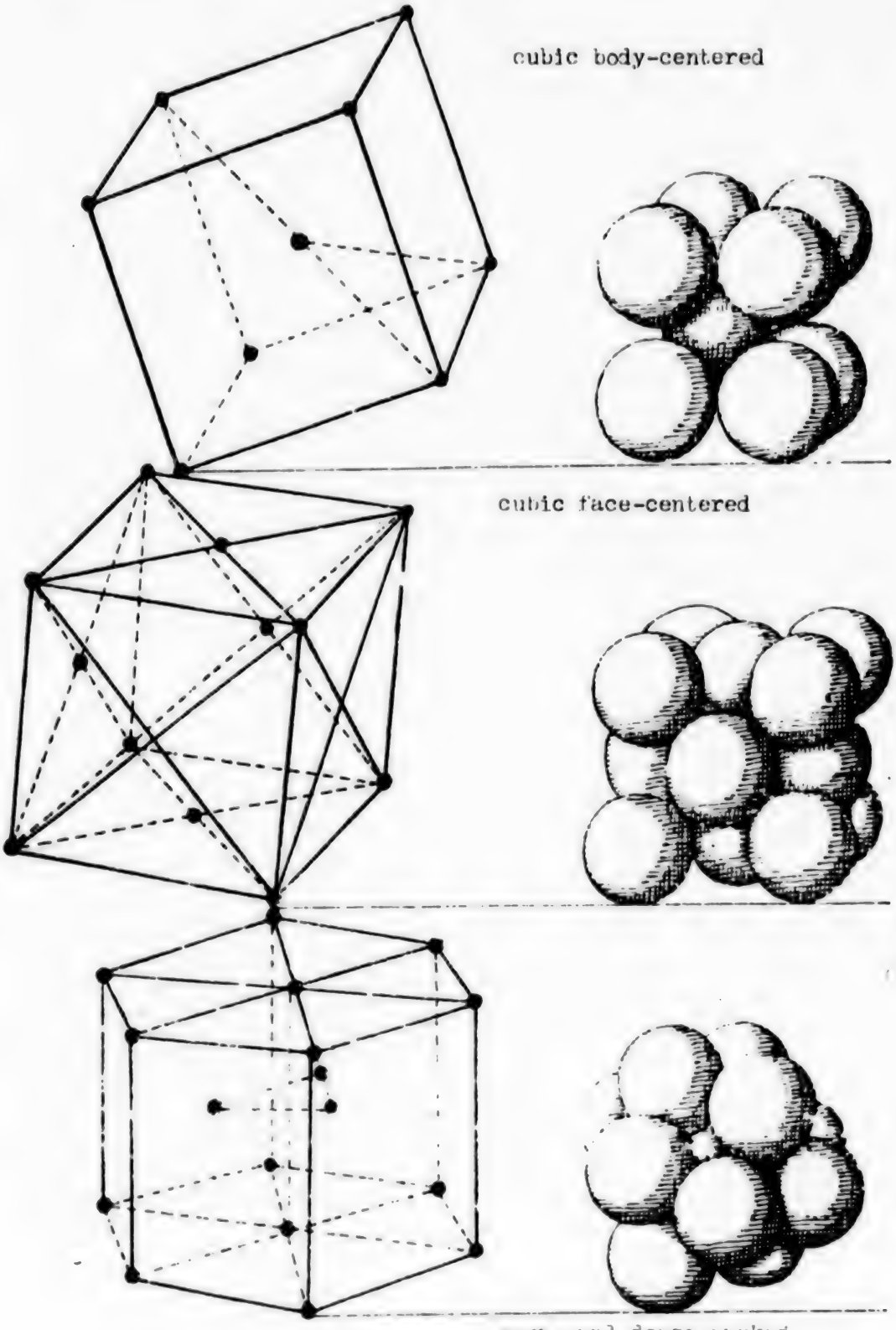
They have long been used in basic research to determine the properties and constants of elements. In recent years, these materials have also been used more and more for basic research in nuclear physics. Thus, in the study of several nuclear reactions, targets of monocrystalline tungsten and not only its monoisotropic form but also its monizotropic form (tungsten-186) were used by physicists at the Neutron Physics Laboratory of the Joint Institute for Nuclear Research in Dubna to study the fine interactions between neutrons and electrons. They stated that by using monocrystals instead of powder, there were able to increase the measured effects by hundreds of times.

The monocrystals of many metals and above all, the high-melting, are technically important materials. Monocrystalline tungsten and molybdenum are used in electronic and lighting apparatus both of which place strong demands on reliability. The same materials have been found to be the best emitters in atomic beam detectors(emitter comes from the Latin emitto meaning "I release") and have also made it possible to increase the precision and stability of time and frequency standards. Tungsten monocrystals along with some highly-pure rare-earth metals are now necessary for the creation of lamps required for the the accurate transmission of color television images.

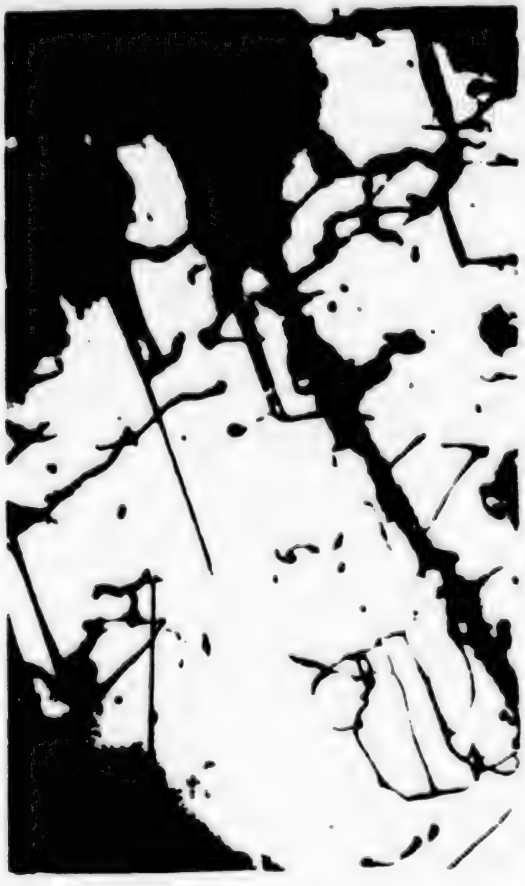
With regard to rare-earth elements, there are also intermetallic compounds of the $SmCo_5$ type that several ye rs ago caused a real boom among the consumers (and producers) of permanent magnets. These intermetallic iron-free compounds were found to have unique magnetic characteristics. Experiments now indicate that these materials, prepared in the form of monocrystals, have even more enhanced characteristics but the research, synthesis and use of these and metal compounds in the form of monocrystals (borides, nitrides and carbides) is only beginning. This is something completely new and it is too early to say what practical results it will have.

However, it can already be said with some certainty that the development and mastery of the production of a new class of inorganic materials--high-purity monocrystals of metals, alloys and compounds--has opened up new possibilities for the creation of modern equipment which will even more actively contribute to the acceleration of scientific and technical progress.

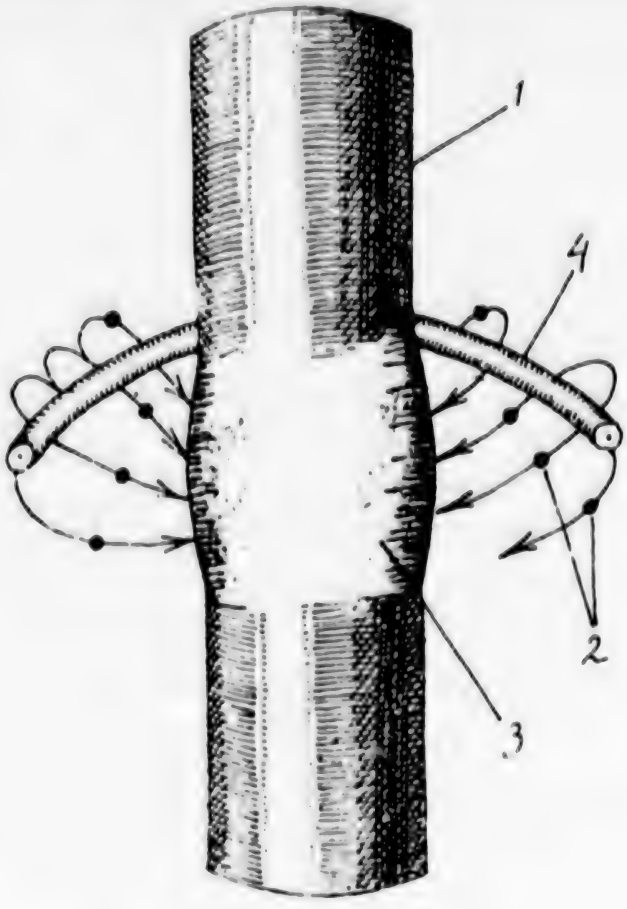
Some crystalline structures of metals



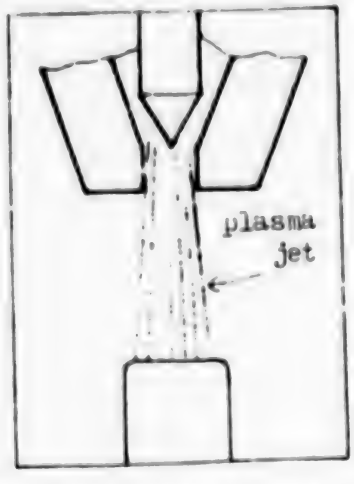
A 40 mm wide tungsten monocrystal made at the USSR Academy of Sciences Metallurgical Institute by the plasma-arc method.



A dislocation in a tungsten monocrystal enlarged 6400 times under an electron microscope.



Electron-beam zone melting: 1) cylindrical sample; 2) electrons whose movement accelerates the electrostatic field formed between the cathode and the specimen; 3) melted zone; 4) cathode



The production of a monocrystal of a high-melting metal by plasma-arc melting is quite similar to electron-beam melting except that a plasma arc serves as the energy source.

What to read about metals, alloys and other metallic compounds in the form of monocrystals:

E.M. Savitsky and G.S. Burkhanov, "Monokristally tugoplavkikh i redkikh metallov i splavov" [Monocrystals of high-melting and rare metals and alloys], Moscow, Nauka, 1972.

G.S. Burkhanov, "Kristallizatsiya karbidov i boridov iz ikh rasplavov" [The crystallization of carbides and borides from their melts], ZHURNAL VKhO IMENI D.I. MENDELEYEVA, 1985, No 6.

12261
CSO: 1842/213

NEW ASSOCIATION PRODUCES MACHINE-TOOL ELECTRONICS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 Sep 86 p 1

[Text] Leningrad (TASS)--The new Tool Association imeni S. P. Voskov in Leningrad has been formed to expand the output of electronic monitoring devices for automated metalworking equipment. Yesterday, the first shipment of products carrying the new firm's name was made to machine-tool builders in Moscow, Leningrad and Ivanovo.

These products include sensors for checking the operating condition of machine-tool modules, machining centers and mechanized lines. The devices ensure that the technological conveyor will operate at a stable pace, reacting even to micrometric deviations from the required metal-cutting precision.

"The output of highly sensitive measuring devices had to be increased to meet the increased output of new-generation machine tools, which are determining progress in many industrial sectors," said Ye. Solovyev, general director of the association. "The creation of a single firm from separated plants permits the integrated delivery of products. For example, complete shipments of various types of machinery will include cutting tools and microprocessor-based measuring devices. Combining the efforts of specialists within the framework of a single enterprise will help shorten the cycle of new-product development."

12595
CSO: 1842/2

INTERSECTOR CONFLICTS HINDER PROGRESS IN PART ROLLING

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 Sep 86 pp 1-2

[Article by V. Sinitskiy, general director, NPO VNIImetmash, and V. Mukonin, department chief, under the "Reserves of New Technology" rubric: "Tsentrodetal for All"]

[Text] Production people often say that "Individual machine tools and machines don't bring revolutionary advances. We need integrated solutions in the form of new technologies, which will produce high-quality products with minimum expenditures." This requirement has been reflected in the decisions of the 27th party congress, which has posed the following task: to ensure the broad implementation of fundamentally new technologies, which will make possible manifold increases in labor productivity and resource-use efficiency and corresponding decreases in the energy- and material-content of products.

What is the fastest way to fulfill this task? We hope to hear the answer to this question from authors under our new rubric, "Reserves of New Technology." This rubric will be devoted not only to the advantages of new production methods. A distinguishing feature of many progressive technologies is that their widespread implementation requires new organizational forms during the development phase, a rejection of the ordinary production structure and courageous steps on the part of ministry and departmental personnel.

We begin our new rubric with the article "Tsentrodetal for All," and we're hoping that our readers will actively participate. We're waiting for your questions, suggestions and proposals.

(signed) Department of Science and Technical Progress, SOTSIALISTICHESKAYA INDUSTRIYA

Reducing metal chip losses by 12-45 percent, reducing the volumes of machining and the need for machine tools by 87-90 percent and significantly

improving the strength and service life of parts are all goals that can be achieved with a fundamentally new technology realized in part-rolling machines. However, attempts to expand the use of these machines have been stalled at the intersector boundary. Metallurgists categorically do not want their product list to include the word "part," while the concept of "rolling" is foreign to machine-tool builders. How can this departmental incompatibility be overcome?

When the famous sculptor Rodin was asked how he created his masterpieces, his answer was brief: "I take a piece of marble and remove all the excess." In essence, this same technology has been dominant in machine building: in order to obtain parts of the proper dimensions, thousands of machine tools and presses "remove all the excess" from blanks of simple shape. In all, nearly 30 percent of the initial rolled product, which itself is not cheap, becomes chips and scrap. The saddest aspect of this is that the enormous expenditures of time, effort, energy and tools result not in the masterpiece of a designer's imagination, but in ordinary, widely used parts.

It was namely with these parts in mind that VNIImetmash [All-Union Scientific-Research and Project-Design Institute of Metallurgical Machine Building] developed a fundamentally new pressure-metalworking technology and developed machines which have come to be called part-rolling machines. These machines, using the continuous-rolling method, can produce parts with dimensions and shapes very close to those required. Because of this, the parts require only minimal machining or none at all. The coefficient of metal use increases to 0.92-0.95.

The advantages of this technology already have been proven in numerous examples, and metal savings are not the only advantage: as a rule, productivity increases sharply when the new method is used. Say, that forging of one ball for a ball mill used to take about a minute; in that same minute, rolling can produce up to 180 balls. The manufacturing cycle for the 2-meter rotors of mining motors is reduced from 6 hours of milling to 6 minutes on the rolling machine. For mass-production items such as drills, the manufacturing productivity increases 15- to 20-fold.

At the same time, this presents broad possibilities for reducing the number of machine tools, which also means reducing the number of machinists. Thus, for example, rolled sprockets for agricultural-machinery chain drives do not require any machining, while shafts for automobile gear boxes go directly from the rolling machine to the grinder, bypassing the turning operations. For manufacturing apron-conveyor spindles, one rolling machine can replace 40 lathes. One of the advantages is higher part strength: gear teeth, for example, are nearly 30 percent stronger.

Our industry already has over 500 part-rolling machines. At first glance, that would seem to be a lot. However, based on the tasks for accelerating economic development, at least 10 times that number are needed.

These machines are now mainly used in the giant machine-building enterprises engaged in mass- and large-series production, such as the Moscow Automotive Plant imeni I. A. Likhachev, the Kama Automotive Plant, the Rostov Agricultural Machine-Building Plant, the Chelyabinsk Tractor

Plant and the Kirov Plant in Leningrad. There are hundreds of times more small and medium-size enterprises, which have practically none of this progressive equipment. Overall, these smaller enterprises convert the vast majority of metal into parts. In addition, it is at these enterprises that the practice of "natural economy" engenders production overexpenditures.

What is hindering the use of part-rolling machines here? As paradoxical as it might seem, their high productivity is the cause. If such a machine is capable of producing several thousand parts per hour, then the average enterprise cannot provide sufficient load. Furthermore, these enterprises cannot afford to have a whole range of machines for manufacturing several kinds of parts. From this, it was concluded that for maximum efficiency, part-rolling equipment must be concentrated in regional production facilities, which would provide products for nearby enterprises. Specialists called these plants Tsentrodetal, by analogy to Tsentrolit.

Originally, this idea was developed in connection with the problem of scrap recycling in ferrous metallurgy. Two and a half years ago, Academician A. Tselikov wrote an article for SOTSIALISTICHESKAYA INDUSTRIYA entitled "On the Path Toward Mini-Plants." This article raised the question of developing regional metallurgical enterprises, which would use local scrap for raw material and produce parts on part-rolling machines. Calculations showed that the production of parts at such an enterprise with an annual capacity of 250,000 tons of molten steel would save up to 100,000 tons of metal, replace nearly 1400 units of forging-press and metal-cutting equipment and release about 1000 workers.

As a first step, specialists of VNIImetmash, the Ural Scientific Center of the USSR Academy of Sciences and Uralgipromez [Urals State Project Institute for Metallurgical Plants] proposed to re-equip the Nizhneserginskiy Metallurgical Plant, which has long been in need of reconstruction. Realization of this project would have solved many problems of machine-building enterprises in the Urals, primarily in Sverdlovsk Oblast. But, despite the obvious advantages, USSR Minchermet [Ministry of Ferrous Metallurgy] and its leading project institute Gipromez [State Union Project Institute for Metallurgical Plants] opposed it. Behind all their doubts and apprehensions, it was clear that they did not want to burden the sector with the production of machine-building parts, which are not on the ferrous-metallurgy product list.

The question of the fate of the Nizhneserginskiy Metallurgical Plant was considered several times at various levels, right up to USSR Gosplan [State Planning Committee]. All sides admitted the feasibility of reconstructing the plant with the establishment of part-rolling production. But, as they say, the cart is still where it was: USSR Minchermet personnel undertook no real measures. In addition, while building new mini-plants, they are staying with the classical arrangement: producing traditional rolled products. It is well known that this will be much more expensive than at large metallurgical enterprises. And even then, the rolled products still have to be machined into parts, thus turning lots of metal into scrap.

The reason for these implementation difficulties is often perceived to be that part-rolling machines are on the boundary between sectors. In fact,

one of the main advantages of these machines is their ability to bridge the gap: they connect metallurgical and machine-building production into a continuous flow. In recent years, the idea of Tsentrodetal plants has been developed further. While trying to achieve maximum efficiency, specialists have concluded that metal-cutting and other equipment should be placed directly after the part-rolling machines, so that truly ready-to-assemble parts can be produced.

There is also a technological necessity for linking these two sectors: our specialists encountered this with a part-rolling machine to make globoid worm gears for automobile steering mechanisms. Despite all the advantages of this machine, the Gorkiy Automotive Plant has refused to use it. Why? Because the parts come off the machine randomly. For the next machining operation, the parts must be precisely mounted in the machine tool. This is an additional operation, thus tipping the scales in favor of the existing automatic lathes at the enterprise: these lathes turn the parts from solid rods, which are automatically fed in. The large chip losses inherent in this technology do not disturb anyone: they are actually the rule in our machine-building industry. It is clear that the choice would have been different if the part-rolling machine and the machine-tools for subsequent machining had been designed as a unified equipment system, with synchronized operations and automatic transfer of parts by robotic or other devices.

From this, it is easy to envision the "post-metallurgical" section of Tsentrodetal plants: it will contain a group of readjustable part-rolling machines capable of producing the parts needed by customers in the region. Rotary lines or flexible machine-tool systems will perform the subsequent machining. True, a special approach is needed to designing these systems, the machine tools in them and, especially, the transport network; this approach must take into account that the rolled parts require minimal, but various types of, machining. Finally, this equipment system must provide for the realization of the advantages of group machining.

All the prerequisites for realizing this concept are present. Machine building sectors have already gained considerable experience in developing flexible manufacturing systems. It is fairly easy to resetup modern automated part-rolling machines to produce modified articles, and these machines can be equipped with robot-loaders. Moreover, specialists of VNIImetmash, in conjunction with the Kharkov organizations of Minstankoprom [Ministry of the Machine Tool and Tool Building Industry], have already developed a machine which rolls multidiameter shafts and which can be converted from one configuration to another during operation by means of its numerical control system.

In this regard, mention must be made of Minstankoprom's position. It is namely this ministry which is responsible for providing equipment for auxiliary production facilities. It is also the leading ministry in the area of robotization and the implementation of flexible systems. The personnel of this ministry do not openly refute the necessity of developing unified machine systems combining part rolling with subsequent machining. But in fact, they are not rushing to realize this idea.

One gets the impression that the word "rolling," which is foreign to this sector, scares the Minstankoprom specialists, who have been educated in the experience and traditions of metalcutting. In fact, the roots of their resistance are in the long-standing argument about who is to produce part-rolling machines. So far, most of these machines have been manufactured by the Ministry of Heavy and Transport Machine Building. However, most of these machines--especially those for rolling small parts--are similar in size and design to ordinary machine tools. According to the logic of things, the production of part-rolling machines should have been assigned long ago to Minstankoprom, since this production would result in declining machine-tool production. Thus, the danger faced by the ministry personnel is that once they agree to develop unified equipment systems, they will not be able to avoid manufacturing the part-rolling machines.

This problem is now clear to everyone, including the people at all-union Gosplan. It is senseless to expend effort, money and capacity to produce masses of machine tools, numerical-control systems for them and cutting tools if the operations performed by these machine tools can be eliminated simply by the broad implementation of part-rolling machines. But, while the Tsentrodetal plants are still in the project phase, machine builders require ever more machine tools. Furthermore, the hypnosis of these requirements has an ever stronger effect not only on clear thinking, but also on calculations.

Evidence of this is the present five-year plan: it calls for the development of only four part-rolling enterprises. Furthermore, without metallurgical production, they will operate on purchased rolled metal. But even this modest program is being implemented at a snail's pace. Possibly only the Ukrainian Main Administration of Material and Technical Supply, which is building one of these enterprises near Kharkov, is working energetically enough, clearly demonstrating the advantages of the extradepartmental approach.

According to general opinion, part-rolling technology is one of the few scientific-technical achievements which meet the main requirements of the acceleration strategy: this technology guarantees a sharp increase in labor productivity, improved product quality and considerable resource savings. It is no less important that the area of realization of these advantages is that key sector: machine building. In our opinion, these are important arguments in favor of broad implementation. The distinguishing features of this technology indicate that this problem must be solved at an intersector basis, taking into account the vital regional requirements. As a first step, Gosplan, the State Committee for Material and Technical Supply and the State Committee for Science and Technology this year should develop a long-term program for establishing Tsentrodetal plants and organizing production of equipment for them. It's time for the energy of bold ideas to be translated into the energy of bold actions.

12595
CSO: 1842/2

GSSR POWDER METALLURGY RESEARCH, PRODUCTION EXPANDING

Tbilisi ZARYA VOSTOKA in Russian 3 Oct 86 p 2

[Article by Yuriy Kartvelishvili, deputy science director of the Institute of Metallurgy, Georgian Academy of Sciences, and director of the Republic Scientific Center for Powder Metallurgy and Powder Coatings, under the "Achievements of Science and Engineering For All Sectors" rubric: "By New Technologies"]

> [Text] Our republic has all the necessary conditions for the broad development of powder metallurgy. There must be a determined effort to accelerate this important matter.

The recently adopted decrees of the CPSU Central Committee and the USSR Council of Ministers provide specific measures for accelerating the development of powder metallurgy in order to meet the economy's demand for metal powders and articles made from them, as well as to raise the technical level of powder metallurgy by implementing leading technology. A Republic Scientific Center for Powder Metallurgy and Powder Coatings has been established, based on the department of powder metallurgy of the Institute of Metallurgy, GSSR Academy of Sciences. This center consists of scientific-research laboratories, departments, a design bureau and an experimental base. The center performs scientific research, testing, design and implementation. It also coordinates and monitors the fulfillment of scientific research and testing-design work in the area of powder metallurgy and powder coatings at enterprises belonging to the GSSR Council of Ministers, as well as at union enterprises located in the republic. An integrated target program of scientific-research, test-industrial and implementation work was developed for 1981-1985 and for the period until 1990.

Based on developments made at the scientific center, powder metallurgy sections have been and are being established at a number of the republic's enterprises in the systems of Gosagroprom and of the ministries of local industry and motor transport; the Rustavi Metallurgical Plant and the Batumi Electromechanical Plant; the Imeni Dimitrov Plant; the Analitpribor Scientific Production Association and the Imeni 50-letiye SSSR and Stankostroitel Production Associations. Also, the powder-metallurgy section at the Elektrovozostroitel Production Association in Tbilisi is being expanded to bring part production up to 450 tons per year.

The Republic Scientific Center studied the product lists of a number of the republic's industrial enterprises and found that up to 6000 tons of articles can be made by powder-metallurgical methods, including 4500 tons from ferrous-metal powders. Based on the center's preliminary economic feasibility study, the republic Gosplan [State Planning Committee] and USSR Gosplan are presently considering the establishment of a 6000-tons/year regional intersector powder-metallurgy plant in the republic.

The Republic Scientific Center for Powder Metallurgy and Powder Coatings has developed about 40 new patented, high-efficiency technological processes for obtaining powdered metals, alloys and compounds which have no analogs in this country or abroad.

All of these efforts were made and are being made in the framework of the all-union and republic integrated scientific-technical target programs and are being realized at the country's largest enterprises, including the Rustavi Metallurgical Plant. On the basis of the results obtained, the Giprostal Institute [possibly State Institute for the Design of Steel Industry Enterprises] of the USSR Ministry of Ferrous Metallurgy has made a technico-economic feasibility study on organizing the industrial production of powdered metals and alloys, which would provide savings of 50 million R per year.

A Transcaucasus Regional Scientific Center for Powder Coatings has been established within the Republic Scientific Center for Powder Metallurgy and Powder Coatings of the Institute of Metallurgy, Georgian Academy of Sciences.

Presently, metal-rolling enterprises produce large amounts of highly polluting pickling solutions as a result of hydrochloric- and sulfuric-acid treatments. The problem of how to fully neutralize these solutions has not yet been solved. The Republic Center for Powder Metallurgy has developed a new technological process for integrated treatment of pickling solutions and toxic production wastes. This process, which is being implemented at the Rustavi Metallurgical Plant, will completely neutralize these solutions and also make it possible to obtain hundreds of tons of iron powder annually.

Considering the fact that 6000 cubic meters of spent pickling solution are produced every year at the Rustavi Metallurgical Plant, this integrated-treatment technology will produce 2000 tons of ammonium sulfate and 900 tons of magnetic ferric oxide, the reduction of which would produce 650 tons of iron powder per year. This would fully meet the present demands of republic enterprises which manufacture various articles by powder-metallurgy methods.

The center has developed new technological processes for obtaining composite powders which permits the wide practical application of these powders in a number of economic sectors. Composite powders, for example, are being successfully used to manufacture sintered articles with special physico-mechanical properties etc.

The center has developed a technology for hardening cold-working dies and several types of cutting tools using the electric-spark alloying [ESA] method, taking into account the specific conditions under which these dies and tools are made at the Batumi Electromechanical Plant. Especially significant savings from the implementation of this technology can be achieved by alloying with hard-alloy materials the tooling and individual parts of tube-drawing mills and tube cold-rolling mills. This alloying is now being performed in the tube-drawing shop of the Rustavi Metallurgical Works.

Powder metallurgy is opening up broad prospects for restoring worn parts.

In our republic, thousands of various machinery and mechanism parts, including motor crankshafts, are being remelted every year. Until recently, crankshafts were considered unrestorable. However, research has shown that flame spraying the shaft surface with chromium-containing powders not only restores the parts, but also increases the wear resistance 3- to 4-fold. This method also can be used to restore other parts.

The Transcaucasus Regional Scientific Center for Powder Coatings has set up sections to apply coatings and restore worn parts at a number of the republic's industrial enterprises: the Batumi Electromechanical Plant, Rustavi Metallurgical Plant and in the system of the Ministry of Motor Transport. The center is now establishing a section in the GSSR Gosagroprom system. At the Batumi Electromechanical Plant alone, the savings total more than 50,000 R. When this method is implemented in the republic's leading economic sectors, the savings will total more than 15 million R per year.

A decree of the GSSR Council of Ministers provides for the following during the 12th Five-Year Plan: 1) establishment of production sections to restore worn parts at the Tskhinvali and Gudauta Automotive Repair Plants of the Republic Ministry of Motor Transport and 2) reconstruction of the experimental shop of the Scientific-Research Institute of Composite Systems and Coatings in the village of Kazreti, raising its capacity to 100 tons of powder per year. In the system of the Ministry of Local Industry, experimental production of gas-thermal coatings to repair and surface-harden worn parts is to be established in Tsnori. Under the scientific guidance of the Republic Center, a head scientific-experimental center with a training-production combine for restoring machinery and mechanism parts is to be established at the Digomi Repair-Mechanical Plant of GSSR Gosagroprom.

High-porosity cermet materials produced by powder-metallurgy methods are becoming increasingly important in modern engineering. Cermet filters made of bronze, iron, titanium, nickel and other metals and alloys are widely used in industry.

The Republic Center has posed for itself the task of developing porous permeable sintered materials [PPSM] and testing them in the food and other industries to filter fine mechanical impurities from various liquids. This work is already underway and good results have been obtained.

Today, the GSSR has a good foundation for the active and broad development of powder metallurgy. However, the presently achieved production volumes for powder-metallurgy articles are insufficient and do not meet the real demands of the republic's economy. Ministries, departments and many industrial enterprises in the republic do not use powder-metallurgy methods, despite the economic feasibility of these methods for producing many different articles.

In order to improve the efficiency of scientific developments, accelerate the implemention of these developments into production and develop metallurgy on an integrated regional basis, the republic's leadership has decided in 1986 to begin construction of a laboratory building and experimental base for the Republic Scientific Center for Power Metallurgy and Powder Coatings. This will greatly accelerate fundamental and applied scientific research, testing, design and implementation.

In order to accelerate the development of the scientific fundamentals and technological processes linked with various aspects of powder metallurgy, the USSR Council of Ministers has organized a Powder Metallurgy Intersector Scientific-Technical Complex. The lead organization in the complex is the Institute of Materials Science Problems, UkSSR Academy of Sciences. Taking part in this work are: a number of sector union ministries; the Ministries of Higher and Secondary Specialized Education of the USSR, RSFSR and UkSSR; the BSSR Council of Ministers and the USSR and GSSR Academies of Sciences, in particular the Institute of Metallurgy of the GSSR Academy of Sciences.

During the 12th Five-Year Plan, USSR Gosplan is to allocate capital investments and money to these ministries and departments for the acquisition of equipment for the construction, reconstruction and re-equipping of powder-metallurgy experimental bases. This is an enormously important task: to make maximum use of these resources for the wide propagation of this progressive method in the economy.

12595
CSO: 1852/2

UDC 66.046.44:538.245

STRUCTURE FORMATION AND GAS LIBERATION UPON VACUUM LIQUID-PHASE SINTERING OF FERRITES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 86
(manuscript received 15 Nov 84) pp 30-34

[Article by V.M. Minin, Solid State and Semiconductor Physics Institute, Belorussian Academy of Sciences]

[Abstract] This article is a logical continuation of a previous work by the same author, which showed the positive influence of vacuum and liquid phase on the sintering of Li-Mg-Mn ferrite and its electromagnetic properties, and also outlined a technology for preparation of a compacting powder, presented specimen geometries, and described a method of microstructural analysis and magnetic measurement. Studies of formation of the microstructure of the Li-Mg-Mn ferrite containing Bi_2O_3 indicate that the process of sintering can be divided into four stages, which are described. The melt is present in the stages of sintering over 970 K and fully surrounds the grains. All of the intergrain pores are joined by the melt on the grain boundaries, over which any pore may reach the surface of the product through the melt. Convex sectors on grains melt first, as well as small grains. Dissolution of grains in the melt is practically unlimited. Chains of bubbles and channels form the major transport paths for gas between pores and also between pores of the surface of the product. They are complex in shape and structure and combine with the grain boundaries to form a single transport network. The liquid phase is liberated at the surface of the product simultaneously with the gas. A vacuum in the cooling stage intensifies the process of gas and liquid phase liberation. References 8: all Russian.

6508/9835
CSO: 1842/15

UDC 621.762.4:620.18:666.665:669.261:669.111.3:621.89

SINTERING, STRUCTURE FORMATION AND PROPERTIES OF POWDER MATERIALS IN THE SYSTEM CHROMIUM CARBIDE-IRON

Kiev POROSHKOVAYA METALLURGIYA in Russian No 8, Aug 86
(manuscript received 23 Jan 86) pp 39-44

[Article by V.N. Klimenko, V.A. Maslyuk and Yu.V. Sambros, Institute of Materials Science Problems, Ukrainian Academy of Sciences]

[Abstract] A study is made of the sintering process and certain properties of materials in the chromium carbide-iron-carbon system. Materials containing 40, 50, 60 and 70% iron were selected for the experiment. The influence of temperature in the 20-1200°C interval on shrinkage of materials with varying contents of iron powder was studied in order to determine the basic regularities of the sintering process. Specimens were heated at 0.33°C/sec. Up to 800°C, the linear dimensions of specimens of all compositions remain practically unchanged. Increasing the temperature to 900-950°C causes some shrinkage of the alloys. Further increases to 1130°C caused a noticeable reduction in specimen height, and at 1150°C intensive and growing shrinkage begins, resulting from appearance of the liquid phase due to melting of the Fe-Cr-C eutectic. The influence of the quantity of iron on hardness, bending strength and impact toughness was studied. Increasing iron content from 40 to 70% causes a decrease in hardness and an increase in strength and toughness. The mass content of chromium carbide in alloys with iron binder must be 1.5-2 times lower than in alloys with nickel binder to achieve the same hardness, bending strength and impact toughness. References 7: all Russian.

6508/9835
CSO: 1842/15

UDC 621.762.862

IMPREGNATION OF THIN CAPILLARIES WITH Ga-In MELT UNDER THE INFLUENCE OF ULTRASOUND

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 19 Aug 85) pp 27-30

[Article by T.A. Lobova, Ye.A. Bogachev and R.G. Sarukhanov, Moscow Steel and Alloys Institute]

[Abstract] A study is made of the ultrasonic capillary effect in thin capillaries modeling the actual pores in sintered materials which are later impregnated with nonwetting or poorly wetting melted metals. Calibrated quartz capillaries with inside diameters of 1 to 500 μm, sealed at one end, were impregnated with a melt in air when exposed to ultrasonic

oscillations at 22KHz at various intensities. The rise height of the melt in the capillaries increased significantly when ultrasound intensity increased from 5 to 20-35 KW/m^2. The results indicate that the use of ultrasound can achieve impregnation of sintered materials with small cross-section pores to depths of 0.8-30 mm without heating. References 12: all Russian.

6508/9835
CSO: 1842/16

UDC 621.762.5

HIGH STRENGTH CARBON STEELS WITH HEREDITARY THIN CRYSTALLINE STRUCTURE. II. INFLUENCE OF CRYSTAL STRUCTURE DEFECTS IN IRON POWDER PARTICLES ON DISSOLUTION OF GRAPHITE UPON SINTERING

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 3 Sep 85) pp 43-48

[Article by I.D. Radomyselskiy, deceased, A.I. Dzyubenko and A.P. Lyapunov, Institute of Materials Science Problems, Ukrainian Academy of Sciences]

[Abstract] When graphite and iron powders which have been subjected to vibration grinding, thus producing high levels of crystal structure defects, are sintered together at temperatures as low as 750°C, significant quantities of carbon enter the bonded state, and at 830°C a relatively homogeneous pearlite structure is formed in 5 to 10 minutes, indicating the high rate of the diffusion processes involved. The defect content of the crystalline structure of the metal is thus shown to be one of the major factors determining structure formation processes in powder metallurgy. If the metal base of the briquette is in an equilibrium recrystallization state after annealing, significant diffusion of carbon through the α-iron is practically not observed. References 7: 4 Russian, 3 Western (1 in Russian translation).

6508/9835
CSO: 1842/16

UDC 669.295:661.621+666.372

STUDY OF PROCESSES OF FORMATION OF PRODUCTS OF TUNGSTEN-FREE HARD ALLOYS BY SLIP CASTING OF THERMOPLASTIC MASSES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 20 Sep 85) pp 48-53

[Article by N.N. Sereda, G.V. Trunov, V.A. Gunchenko, V.A. Potapenko, I.T. Belik and V.A. Tsyban, Institute of Material Science Problems, Ukrainian Academy of Sciences]

[Abstract] The major purpose of this work was replacement of tungsten-containing hard alloys used in the manufacture of wear-resistant parts whose complex shape prevents their manufacture by cold pressing methods. The initial components used in the production of the tungsten-free type KTS hard alloy were powdered titanium carbide, electrolytic nickel and molybdenum. The use of slip casting of the powdered mixtures required the use of a suitable thermoplastic binder. The binder selected was 90% paraffin plus 10% wax. Evacuation during casting was found to improve all the properties of the slip. The products produced were then heat treated at 300°C in air and 89°C in hydrogen to remove the binder. References 2: both Russian.

6508/9835
CSO: 1842/16

UDC 566.468+532.5

FLAMMABILITY OF MIXTURES OF NIOBIUM AND TANTALUM POWDERS WITH ALKALI AND ALKALI-EARTH METAL PEROXIDES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 86
(manuscript received 3 Oct 85) pp 95-100

[Article by Ye.V. Chernenko, L.F. Afanaseva, M.D. Nersesyan, S.V. Lysikov and V.I. Rozenband, Chemical Physics Institute, USSR Academy of Sciences]

[Abstract] A study is made of the ignition of mixtures of niobium and tantalum powders with powders of oxides and peroxides: Nb_2O_5, Ta_2O_5, Li_2O_2, Na_2O_2 and BaO_2. The variation in flash point, that is, the minimum temperature at the center of the block in which ignition of the specimen occurred, as a function of the mass content of tantalum and niobium powders was in a mixture with Li_2O_2 studied. Addition of slight quantities of Li_2O_2 significantly reduced flammability. Peroxides in mixtures with tantalum or niobium powders were found to have both a passivating and activating influence on flammability. Mixtures of Na_2O_2 with niobium have an activating influence when stored up to two hours. BaO_2 with tantalum also has an activating influence. References 7: all Russian.

6508/9835
CSO: 1842/16

UDC 621.791.754'293.011:669.245'26'28.018.48

RESISTANCE OF WELDED JOINTS IN HIGH TEMPERATURE HASTELLOY N-TYPE NICKEL ALLOY TO HOT CRACK FORMATION

Kiev AVTOMATICHESKAYA SVARKA in Russian No 9, Sep 86
(manuscript received 5 Nov 85; in final version 26 Dec 85) pp 10-12

[Article by K.A. Yushchenko, doctor of technical sciences, V.N. Lipodayev, candidate of technical sciences, M.V. Belchuk, engineer, G.N. Gordan, candidate of technical sciences, Electric Welding Institute imeni Ye.O. Paton, Ukrainian Academy of Sciences, and O.V. Novichkova, candidate of technical sciences, Central Scientific Research Institute of Ferrous Metallurgy imeni I.P. Bardin]

[Abstract] The purpose of this work was to refine the topography and morphology of hot cracks in welded joints of a high temperature nickel alloy in the nickel-chromium-molybdenum system. The crack resistance of welded joints in an experimental hastelloy N alloy was studied. Butt joints of rigidly clamped 10 mm thick plates were made by multipass argon-arc welding with a nonfusible electrode using a 3 mm diameter wire with a composition similar to that of the base metal. Cracks were located metallographically cut out, and then studied on a scanning electron microscope. A microanalyzer was used to estimate the microheterogeneity of the metal in various zones of the joints. The experimental data indicate that the formation of hot cracks in welded joints of a multicomponent nickel alloy of the hastelloy N type is related both to the existence in the crystallizing metal of residual liquid rich in segregated material and to the presence of low-melting-point inclusions at the intercrystalline and recrystallization boundaries of the austenite, causing a drop in the melting point of these boundaries. The welded joints show a tendency to formation of both crystallization and liquation cracks in the seam metal and heat-effected zone. References 5: 2 Russian, 3 Western (1 in Russian translation).

6508/9835
CSO: 1842/17

UDC (621.791.4.052:539.378.3]:621.792.4:539.4.014

STRESS STATE OF WELDED JOINTS OF DISSIMILAR MATERIALS OBTAINED BY DIFFUSION WELDING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 9, Sep 86
(manuscript received 31 Oct 85; in final version 29 Jan 86) pp 13-17

[Article by Ya.V. Lyamin, engineer, R.A. Musin, candidate of technical sciences, Perm Polytechnical Institute, and V.N. Ivanov, candidate of physical-mathematical sciences, Continuum Mechanics Institute, Ural Scientific Center, USSR Academy of Sciences]

[Abstract] A study is made of the influence of the ratio of the dimensions of welded joints on the distribution and magnitude of residual heat stresses. It is assumed that the joint is in a linearly elastic state of planar deformation. The distribution of residual stresses in an uncompensated ceramic-metal joint is found to be significantly influenced by the ratio of the thicknesses of the welded materials and the relative thickness of the entire joint. The end zones in which stresses are concentrated to levels which are dangerous for fracture vary in size as a function of the ratio of thicknesses, encompassing the entire length if the thicknesses are greater than actual stresses due to partial stress relaxation upon cooling. References 11: 9 Russian, 2 Western.

6508/9835
CSO: 1842/17

UDC 621.791.754'264.037:629.12.011.7

PORTAL-TYPE INSTALLATION FOR AUTOMATIC WELDING OF SHIP HULL STRUCTURES IN CO_2

Kiev AVTOMATICHESKAYA SVARKA in Russian No 9, Sep 86
(manuscript received 29 Jul 85) pp 38-39

[Article by V.V. Kudashkin, V.I. Pyshkin, M.K. Trosheykin and V.N. Khomyakov, engineers, Nikolayev]

[Abstract] A portal-type installation has been developed and introduced into flow-line mechanized production which is intended for the welding of longitudinal and transverse deck framing, stringers, bilge brackets and other units and structures of a ship's hull. Continuous or interrupted seams can be welded on one or both sides of structures in CO_2. A constant distance is automatically maintained between the welding jets and the material being welded even for curved seams. Operation of the device is briefly described. The use of the device can increase the productivity of welding operations by a factor of 1.5-2 in comparison to previously used methods of mechanical welding. The device has a 6.3 meter track, a 2 meter

wheel base and welds at a rate of 0.145-1.450 m/min. The mass of the device is 5680 Kg. References 2: both Russian.

6508/9835
CSO: 1842/17

UDC 621.791.72.037

OPERATION OF MULTISTAGE POWER SUPPLIES FOR ELECTRON BEAM WELDING INSTALLATIONS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 9, Sep 86
(manuscript received 10 Jul 85; in final version 24 Feb 86) pp 40-42, 62

[Article by G.I. Leskov, doctor of technical sciences, and G.A. Loskutov, candidate of technical sciences, Electric Welding Institute imeni Ye.O. Paton, Ukrainian Academy of Sciences]

[Abstract] Previous studies have analyzed multistage combined systems of rectifiers with parallel supply of primary windings of transformers of the stages assuming equality of active and reactive impedances. In transformers with isolated core with series power supply of transformers these conditions are not observed. This article therefore performs an additional analysis of the operation of these devices together with the rectifier stages. The difference in amplitude and phase shift of the currents in the stages is considered. Due to the phase shift of the currents in the stages, the maximum voltage across the load is decreased, as is its pulsation factor. References 6: all Russian.

6508/9835
CSO: 1842/17

RESTRUCTURING OF KOLA RESOURCE DEVELOPMENT DISCUSSED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 Aug 86 p 2

[Article by L. Tsvetkov, SOTSIALISTICHESKAYA INDUSTRIYA special correspondent: "Kola Project: 2. To Legally Request"]

> [Text] In our previous letter, we acquainted the reader with several problems of developing the Kola Peninsula deposits (SOTSIALISTICHESKAYA INDUSTRIYA, 28 Aug 86). A new agency of USSR Gosplan [State Planning Committee]--the Kola MVTK [Interdepartmental Territorial Commission]--is helping greatly to overcome the departmental approach to these problems. This agency operates as a structural subdivision of Gosplan in Murmansk. Today, we will discuss how the agency's work is unfolding.

Murmansk--Circumstances did not allow any time to contemplate about where the commission should start or how it should act. The commission was formed at the very end of 1984. USSR Gosplan and the ministries were already working at top speed on projects for the 12th Five-Year Plan. There still was no well-structured development strategy for the Kola Mining-Industrial Complex. The strategy had to be formulated and "claims" had to be "staked" with requests in the 1986 plan and the five-year plan. In other words, the commission staff had to stuff a pile of well developed proposals into their pockets before jumping on the already-moving "planning express."

Without revealing any secrets of his "machinations," V. Zhiboyedov, deputy director of the commission, said tersely: "If the sector departments of Gosplan pushed us out the door, we would crawl in through the window." One can guess what he's talking about: it's not enough to be familiar with the corridors and cornices of the Gosplan building. One still needs insurance from the ministries developing the Kola deposits. But on whom to rely? Experience suggests that in raw-materials sectors, if the plans are fulfilled, the people who run the refining enterprises which produce the end product are at the zenith of glory. And if the plans are not fulfilled, then the buck stops with those responsible for the ore base. The commission sought support from these deputy ministers and at these all-union production associations, since in the final analysis, the

commission was making their work easier. Within a year, the planning committee approved a program for the integrated use of Kola resources. And the necessary projects were given separate lines in the annual and five-year plans.

What projects are we talking about? These include: a gravel crushing-sorting complex in Olenegorsk; the facilities needed for more complete extraction of phosphates at the Kovdor GOK [mining-enrichment combine]; four large facilities for the Apatit Association and an experimental industrial base for the Afrikanda Ore Administration of USSR Mintsvetmet [Ministry of Nonferrous Metallurgy]. We have heard many times about this last project. For in Afrikanda, which has survived the tragedy of an abandoned village near a decaying, subsidized mill, the foundation is being laid for a large and promising new development: the intersector scientific-technical complex of the All-Union Scientific-Research and Project Institute of Mechanical Processing of Minerals. The Gosplan personnel in the commission's working apparatus have been of considerable service in getting things included in the annual and five-year plans. But the development and justification of the proposals would have been impossible without local specialists. And here, the Murmansk party obkom must be given its due: it did not hold back personnel, but rather gave the commission its best people. Thus, the new administrative agency was headed by P. Markov, former chairman of the oblast planning commission. G. Afanasyev, who came to the commission from the post of deputy chief of Glavmurmanskstroy, handles the construction problems. Skilled geologists, mining engineers, metallurgists, ore-dressing specialists, economists and financial personnel were hired. Despite the pressing situation, the personnel were selected carefully. The result was an array of people with a common trait: namely, devotion to the idea of integrated resource development.

Several more words are in order about the foundation of the new agency: the public part of the interdepartmental commission. This includes representatives of the central economic agencies, ministries and sector and academic science and the directors of the largest Kola mining enterprises. The latter often set the tone for the entire work. And I hope that the reader understood what that tone is from the previous letter: skimmers feel extremely uncomfortable next to local managers.

I also hope that the reader was able to grasp another idea: the central agencies' intentions of harmoniously developing the Kola Mining-Industrial Complex can best serve the aspirations of local managers, specialists and scientists. It would seem that one could not ask for more. The blueprints for solutions to most problems have already been made: now people need to take the initiative and put them on the planning track. But this soon becomes just a pipe dream...

Let's return to a specific situation at the Apatit Association, with which the previous letter concluded. In and of itself, the idea of integrated use of the Khibin ores--in particular, nepheline--to increase aluminum production is very attractive. There is still not enough of the "winged metal" for all consumers, and it is strictly rationed. A considerable amount of the raw material is purchased abroad. It would make perfect sense to

open all the floodgates so that nepheline concentrate could flow from the Kola Peninsula in the same large volumes as apatite. Meanwhile, a sorry trickle of nepheline is barely flowing.

Is it because of insufficient capacity? No, the capacity has been developed, and part of it even had to be converted to apatite production. Is it that the refining technology has not been perfected? Not that either. For several years, the Khibin nepheline has been supplying the Glinozem Association of USSR Mintsvetmet in Pikalevo, which in turn supplies the Volkhov Aluminum Plant. At one time, significant expansion of these two enterprises even was planned, along with construction of three new enterprises. But everything came to a halt: Mintsvetmet refused to confirm its need for the Khibin concentrate.

It is hard to describe just how much disappointment this caused on the peninsula. The now-unwanted nepheline is gradually ruining Imandra, the gem of northern lakes; is smothering the easily damaged arctic flora and is simply being destroyed by dust storms and thus lost as a national treasure.

But let's listen to the "accused." What can counter their assertions on the unfeasibility of expanding the existing enterprises? Here, the matter is not so simple. With the traditional technology, the production of alumina is invariably also the production of cement: you can't just discard an enormous quantity of sludge. But the production of cement is profitable only in a limited consumption zone. If you increase the shipping distance, you can start counting your losses. Consider for yourself: would you personally just rush to defend a fine idea at the office? After all, this is not a place for emotions, but for clear choices between profit and loss.

I know people who have gone in and defended. However, they went in with an alternative: a cementless technology.

At the Institute of Chemistry and Technology of Rare Elements and Mineral Raw Materials of the Kola Branch, USSR Academy of Sciences, there is an "extraordinary" laboratory chief, V. Zakharov, who has continued to work on nepheline while all the "ordinary" specialists have written their dissertations and then abandoned it. Victor Ivanovich did not abandon it and discovered a method of chemically treating the raw material. Another scientist, Nikolay Aleksandrovich Zyrichev (of the State Scientific-Research and Project Institute of the Nitrogen Industry and Organic-Synthesis Products, Minudobreniy [Ministry of Mineral Fertilizer Production]) took the resulting product and learned how break it down with plasma. The chemical and plasma technologies were combined at the Apatite Association.

There's no room to discuss the new method here. I will only say that it works. Imagine: one can take not only unenriched ore, but enrichment residues. Each ton produces about 1/5 that amount of ready-to-use alumina for aluminum manufacturers; about the same amount of soda ash, which is now imported for chemical production; 70-90 kg of potash, which is also an extremely scarce component for the glass and ceramic industries, and the same amount of phosporous product for agriculture. Also, it produces little-known, but extremely important, byproducts.

In March of this year, the deputy minister for mineral-fertilizer production, A. Kozhevnikov, organized a representative meeting. It was decided that an experimental installation be built at the Apatit Association. The sector staff thus approved preparations for producing a whole spectrum of products, most of which have no relationship to mineral fertilizers.

This is the visible side of the matter. Now for the behind-the-scenes side. The apparatus of the Kola Commission had to work hard in order for the conference to take place and for the decision to be made. Not to offend the specialists of Minudobreniy, but their initial interest was lukewarm. The commission had to overcome even greater skepticism from the representatives of other sectors which were to receive the future production. Therefore, the chief of the central laboratory at Apatit, A. Makarov, had to take product specimens around the country to seek out and convince potential customers. At the same time, the commission members gradually (so as not to offend the Minudobreniy personnel) did an enormous amount of preliminary work to prepare for the deputy minister's meeting.

Among these "workers" was Nikolay Mikhaylovich Volosnikov. After getting to know him better, I was again amazed at the foresight in hiring commission personnel. He is a person with a broad range of interests, a highly skilled miner who has received an excellent education in organizing: he was secretary of the party committee of a large combine and a rayispolkom chairman, coming to the commission from the post of party raykom first secretary. Through erudition, energy and capability, he was able to make the most bureaucratic bureaucrat capable of inspiration with new ideas.

I came to the conclusion that the most unsatisfactory aspect of the new administrative agency is its legal position. The agency's directive document states: perform preparatory and organizational work on integrated resource use. Take any of the commission's protocols: you'll find the words "note," "recommend" and "request." The statute approved by Gosplan for its new subdivision does not permit anything more than that. Can people such as Volosnikov, who know how to make responsible decisions and who are experienced in doing it, be satisfied with such "authority"?

I can envisage the commission being an agency of administrative management. But then it must not manage from behind the scenes, not through someone else's hands, but must have the right, for example, to handle certain capital investments. It must have the right to not only propose, but to confirm plans within its competency.

I can envisage the commission as an agency of economic management, combining the mining enterprises of the kray on a cost-accounting foundation, along the lines of the intersector territorial association of the city of Poti. There are probably other alternatives as well.

But what instead of that? As an experiment, a cost-accounting intersector association is to be organized in Murmansk for integrated refining of secondary raw material. It must be assumed that this would include enrichment residues, which are already being handled by the Kola MMTK.

There is also a plan to establish in the union republics state committees for environmental protection and for regulation of resource use and to establish local agencies of these committees. "Local" means in Murmansk too, where these questions are already being taken up by the Kola MVTK; that is, under the direct methodological direction of USSR Gosplan's environmental protection department. Isn't this the beginning of a duplication of effort?

This is a matter for specialists, whom we invite to speak out on the problems of Kola experiment. This experiment is important not only for the region: this involves the development of one alternative for solving the overall task posed by the 27th party congress: to unify sector, territorial and program planning.

12595
CSO: 1842/2

FIRST DEPUTATSKIY TIN CONCENTRATE PRODUCED

Moscow IZVESTIYA in Russian 11 Oct 86 p 1

[Article by O. Borodin, IZVESTIYA correspondent, under the "Five-Year Plan Chronicle" rubric: "Largest in the Country"]

> As IZVESTIYA has already reported (No 281), preparations are being made to test the enrichment-mill equipment at the Deputatskiy Mining-Enrichment Combine [GOK]. Finally, on 8 October at 4 p.m., the signal was given to load the receiving hoppers and ore began moving on the conveyors... The first tin-ore concentrate had been produced.

This is a great occasion for the construction workers, who under difficult polar conditions are building the world's largest tin-mining enterprise. The entire country is building the combine in Yakutiya. The collectives of 64 plants are supplying equipment for the northern project. During the five-year plan, 178 million R have been utilized, which is well above the plan.

"We're not lulled by our success, there's much work to be done," says N. Gorbach, chief of enrichment at the mill. "At the same time that the equipment is being adjusted and the mill is being readied, we're looking for ways to improve the efficiency of the entire process circuit. The enrichment building is being built in a difficult environment and we are starting up the self-comminution mills."

The GOK complex includes the Zapadnyy Mine, where several kilometers of underground workings have been driven and several other facilities have been built, including the water-treatment installations. In order to keep the Deputatka River clean, two 1.5-km tunnels were driven in the cliffs.

After the first phase of the mill is started up (at the end of December, one year earlier than planned), the construction workers will concentrate on residential and socio-cultural facilities. A combine for large-panel building construction was built back in 1982 in Deputatskiy. Since then, 50,000 square meters of living space have been built, and beginning next year, apartment buildings of a new, improved series will be built. The following are to be built next year: 20,000 square meters of residences and stores, two kindergartens, a bath-laundry combine and a 400-seat club.

12595
CSO: 1842/2

UKSSR MINCHERMET PARTY COMMITTEE CRITICIZED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 12 Oct 86 p 2

[Article by V. Pryadko, SOTSIALISTICHESKAYA INDUSTRIYA correspondent, under the "Party Committee: The Search for New Approaches" rubric: "In the Rustle of Paper"]

> [Text] Dnepropetrovsk--Again there is agitation among the sector staff: people on all floors of the Ministry of Ferrous Metallurgy are discussing the proposed changes in management structure. One might recall that this is already the third restructuring in recent years. First, the number of main administrations was reduced and their staffs were sharply curtailed, in order to more closely resemble the production structure. After a certain amount of time, an additional link was again created: the republican production associations Ukrmetallurgprom, Ukrruda, Ukrkoks and Ukrtrubostal. Now they have decided to eliminate the intermediate associations and... restore the main administrations. All of this is with the aim of improving sector management: reorganizing on the move, so to speak.

Of course, it's not easy to select the optimum management structure, adjust it and target it to improving the entire sector's management mechanism. Meanwhile, the shuffling from a three-link system to a two-link system and back reminds one, if you'll pardon the expression, of the notorious zigzags in men's fashions: from Nehru jackets to leisure suits. But there is practically no advantage from this type of reorganization, although every time it causes a new paper blizzard, overwhelming all levels from the top down with white whirlwinds.

One would like to talk with the ministry's party committee, which has been called in to actively help improve the apparatus's operation and to clearly

fulfill the directives of party and state agencies. Party-committee secretary V. Kutsyr thought that this turn in the conversation was caviling:

"I meet with the minister every day in working meetings to discuss restructuring problems. Thus, the party committee is informed on all matters."

But after all, the party committee is a collegial body, and, judging from everything, only the secretary is "informed on all matters." In recent years, problems of management improvement have not been discussed a single time at party committee meetings, although these discussions have been taking place in the ministerial subdivisions for a long time.

"And we, you know, are paperless," parries Viktor Fedorovich, "we don't have protocols, because it's more expeditious."

Of course, Viktor Fedorovich was being modest about the paper. You can't get by here without it. Portfolios bulge with all different types of instructions, circulars and reports. A paper whirlwind is sweeping the entire sector headquarters. Even now, when it would seem that the year-long shake-up had broken the previous management style, there is still a preference for that old style.

Recently, I visited the ministry's law department. Here, the typewriters were banging like machine guns and one office worker was constantly on the telephone: her task was to transmit a new 19-point reporting form by telephone to all the coke-chemical enterprises in the republic. Who needed the new data and why, no one knew. And these questions could be answered without leaving the ministry building.

Do the party committee members know about this? Undoubtedly, since many of them fill out these papers. A check in the ministry apparatus showed that 110 illegitimate report forms were born this year, including over 180,000 indicators!

The party committee is fully occupied with filling out papers. Many problems are discussed at each session, for example: 1) reclamation of secondary resources at sector enterprises, 2) improving personnel work, 3) organizing work on producing and shipping metal products based on product orders, 4) measures to improve the activeness of organizational-party and education work and 5) measures to make communists in the apparatus more responsible for solving the sector's tasks in light of the CPSU Central Committee decree on the work of the party committee in the Ministry of the Machine Tool and Tool Building Industry. All this at one party committee meeting! And that's not all: they prepare for things in a hurry, without basic preparation.

One other distinguishing feature also jumps out at you: for the most part, the party committee discusses the same things at its meetings that the ministry collegium does. A sort of duplication of effort is taking place or sometimes purely management matters are discussed. Why?

"I can answer that. The collegium almost never punishes," explained the party committee secretary. "We, as a rule, are very strict with the guilty. The party committee, for example, penalized the first deputy minister."

Yes, V. Kutsyr can express tenacity and persistence, especially when talking about production matters. Everyone remembers the case when, thanks to his active intervention, the basicity of blast-furnace sinter was raised and the raw-material base was improved. But in this case the party committee was for workplace certification and for the implementation of the achievements of science and engineering at ferrous metallurgy enterprises. The committee discussed the most important problems "in a heap," as they say, "noted" some things and then quieted down. It did not lower itself to practical organization or to working with people.

Of course, it's difficult sometimes to draw a boundary between party and business matters, as they are often closely intertwined. However, the art of management is to be able to determine this line: when and in what situations a business problem becomes a political problem.

Take the report of the chief of the ministry's control-inspection department at the party committee meeting. Serious complaints were leveled at communist V. Yatsenko at that meeting. And it serves him right! This service has an increasing role in establishing order and observing government discipline. But it's strange that during the discussion, not a word was said about the serious financial violations uncovered by these same controller-inspectors at the Poltava GOK [Mining-Enrichment Combine]. Were they silent because ministry apparatus personnel were directly involved in the violations? Were they worried about publicity?

A group of workers (now former workers) at the Poltava GOK, headed by the director Afonin, chief engineer Krasheninnikov and chief accountant Kapryzin, had long been stealing government property and altering reports. The ministry's order states: "These crimes were possible because the managers and functional departments of the Ukrruda Association, individual deputy ministers and ministry administrations and departments did not exercise the proper control over combine operation or hold the combine director Afonin personally responsible." Next is a list of all the names of people who did not exercise this control. However, not one of them was punished! They escaped with a statement of the facts...

The party committee also remained silent. Earlier still, checks made by that same control-inspection department resulted in four orders noting financial violations at the Poltava GOK. Five years (!) ago, the inspectors proposed that Afonin be relieved of his duties as combine director: otherwise, they said, we won't be at fault for the consequences. But all this was for nothing. After a regular check, G. Bibik, deputy minister of the republic ferrous-metallurgy ministry, began inviting in the control-inspection chief and persistently tried to find out: how are things going, what has the inspection found? It seems that he had hidden reasons for this. It turned out that the deputy minister had participated directly in Afonin's machinations.

V. Kutsyr defends himself by saying, "No official notification or inquiries came to the party committee on this matter. What could we do if we didn't know anything?"

Or did they? After all, the committee did receive instructions to to cut one deputy minister slot. They quickly prepared a tube-mill director's chair for Bibik, while the previous director, V. Chus, was transferred to a different enterprise. Even the order was prepared. And then very unexpectedly, G. Bibik was made a leading engineer in one of the departments of the tube institute. Why was he not entrusted with the director's post, as had been previously planned? It turns out that the party committee knew or guessed about Bibik's goings-on, but did not decide anything about it in public. By the way, no one has explained to the communists of Minchermet why this deputy minister was transferred to engineering.

The bureau of the Dnepropetrovsk party obkom discussed the personal case of communist G. Bibik. For abuse of his official position, namely, illegal enrichment in the manufacture and sale of furniture, he was severly punished with an entry in his record card. But even this decision was not handled openly. Only a few especially trustworthy people were informed, while the rest of the party organization was left in the dark.

So it turns out that the party committee is restructuring the ministry apparatus more in words and on paper than in fact. As before, the facts and events of party and public life at best are stated and noted, while no real war is waged to improve conditions or to make the ministry apparatus personnel more personally responsible for their appointed tasks.

A direct criticism of the party committee was voiced at a recent meeting of the ministry collegium, at which it was said that the creative tension from the competition in honor of the 27th party congress had noticeably slackened in the sector. Back in July, the metallurgical enterprises which had overfulfilled their tasks in the first half year, suddenly fell ill. Minuses suddenly appeared in the monthly reports of such giants as Krivorozhstal, Azovstal and others. In August, as the satirists say, they satisfactorily failed to meet the plan for all indicators. This illness lasted into September. The reason is an old one: during the preparation period, they did not finish all the scheduled summertime measures; therefore, violations of technical discipline became more frequent and labor activity at all levels slackened. It turns out that the same human factor, which is often discussed at party-committee meetings, did not function, and will not, until the committee backs up its words with concrete actions.

12595
CSO: 1842/2

- END -

END OF FICHE DATE FILMED

18 Aug. 1987

M.T.